

Appendix H2. Wildlife Inventory Methods and Results

Appendix H2. Wildlife Inventory Methods and Results

This appendix describes methods used to inventory wildlife species, results of field surveys, and wildlife habitat conditions on the Delta Wetlands (DW) project islands. Wildlife habitat information is based in part on information collected for the 1990 draft environmental impact report/environmental impact statement (EIR/EIS) and has been updated to reflect current conditions where these changes would affect the impact analysis.

As a result of land management decisions made in the last 4 years, some agricultural land uses and wildlife habitat conditions on the DW project islands have changed. Some of these changes were made in response to annual fluctuations in agricultural market conditions; others were made in anticipation of DW project implementation. Because some of these changes have resulted from project-related actions and influences, information from the 1990 draft EIR/EIS (based on 1988 conditions) provides the most reliable description of typical preproject wildlife habitat conditions on the DW project islands for assessing the impacts of the DW project alternatives.

SURVEY AND ANALYSIS METHODS

The DW project islands support a variety of wildlife species. Wildlife species that use the islands were determined from systematic aerial and ground surveys and other information on wildlife in the Delta. Additional specialized surveys were conducted for special-status species (i.e., those species listed as threatened or endangered by the state and federal governments or identified as possibly requiring such protection). Survey coverage included all of Holland Tract. Wildlife use levels described below, therefore, should be considered slightly inflated for Alternatives 1 and 2, which do not include the southwest quarter of the island.

Wildlife species were grouped into three major categories for this report: general wildlife species, waterfowl and upland game, and special-status species. Each of these categories contains species that have different habitat requirements. Thus, wildlife species within the general wildlife and waterfowl groups are presented in subgroups according to their taxonomic relationships or

similarity in their habitat preferences. Special-status species are described individually.

An assessment of the relative value of island habitats to representative wildlife species is presented in Chapter 3H, "Wildlife".

General Wildlife Species

DW Project Islands

General wildlife species in this analysis include species from the following species groups: piscivorous (i.e., fish-eating) birds, wading birds, raptors, shorebirds, gulls and terns, swallows, blackbirds and starlings, and bird species typically associated with grassland and riparian habitats.

Most information used to assess abundance of general wildlife species came from a series of systematic ground surveys conducted on each of the islands during February-May 1988. Survey periods were selected to represent bird use during the wintering period, spring migration, and the breeding season. Ground surveys consisted of a prescribed route being driven on each island, with stops made for about 3 minutes at survey stations 0.5 mile apart. Birds and other wildlife seen or heard were counted at each station and during travel to the next station.

Certain limitations must be considered in interpretation of results of the fields surveys for general wildlife species conducted for this EIR/EIS. First, surveys were conducted only during February-May 1988. This period overlaps the wintering, spring migration, and breeding periods of most species expected to be present on the DW project islands. Abundance of some species, however, may have varied in other months. Second, completing surveys in 1 year does not permit evaluation of year-to-year variation in population levels. A third limitation is that inherent differences in the detectability of species prevents valid comparison of abundances of different species. Thus, discussions of abundance are limited to generalized statements of relative abundance of individual species, comparison of abundances of related species with similar detectabilities, and comparison of abun-

dances of the same species or species groups on different islands. Ground survey coverage of each of the project islands is summarized by island and by month in Table H2-1.

Large, conspicuous birds (e.g., egrets and great blue herons) were also counted during aerial surveys conducted on the four islands from November 1987 to May 1988 and October 1988 to January 1989. (The following section on waterfowl and upland game contains more information on aerial surveys.) Additional ground surveys were conducted at the Holland Tract demonstration wetland to assess water bird use during various seasons and under various water management activities. Special surveys of riparian areas were also conducted on foot to determine general species present.

Habitat types were recorded at each of the ground survey points. Occurrence and abundance of species groups (e.g., raptors and shorebirds) and of the most abundant species in each group were evaluated within the various habitat types present. Habitat types used by large, conspicuous birds were also recorded during aerial surveys. Frequency of habitat use by species was compared qualitatively with habitat availability on the DW project islands to assess habitat preferences.

Delta Region, Suisun Marsh, and San Francisco Bay

Information on general wildlife species in other areas of the Delta, Suisun Marsh, and San Francisco Bay was derived from existing sources, especially Rollins (1977), Jones & Stokes Associates (JSA) et al. (1979), and California Department of Fish and Game (DFG) (1987a, 1987b).

Waterfowl and Upland Game

DW Project Islands

Abundance. Waterfowl counts were made during aerial and ground surveys in 1987-1989 to characterize use of the DW project islands. Aerial counts were considered more complete for waterfowl and therefore are emphasized in the following discussion. Twenty-one aerial surveys were conducted by two observers from a plane flying at 200- to 300-foot elevations from December 16, 1987, to May 9, 1988, and in November 1988. Three or four parallel survey lines were flown across each island to cover all of each island's area. Flights were conducted between 10:00 a.m. and 3:00 p.m. to maximize visibility of birds from the air.

Most geese and swans were easy to identify from the air. Snow geese and Ross' geese, however, could not be clearly distinguished. We refer to all white geese as snow geese in this report; snow geese are the predominant white goose in the Delta, as determined from our ground surveys and discussion with other biologists (Gifford pers. comm.). It was also difficult to identify numbers of each duck species, especially when large, mixed-species groups were encountered. Thus, many records were reported as "duck species". Nearly all identified ducks were mallards and pintails.

Waterfowl counts during ground surveys were made on the same day and at the same time as the aerial counts to ensure that the results of the two methods were similar. Ground counts made on days other than those of aerial surveys were used to supplement results of aerial counts. Waterfowl surveys were also conducted regularly on foot at the Holland Tract demonstration wetland. Ground and kayak surveys were also conducted at the blowout pond on the east end of Webb Tract in June 1990.

Waterfowl population sizes differed substantially among surveys, reflecting the general pattern of movement of wintering waterfowl flocks in the Delta. Therefore, numbers of individuals observed on each island were averaged over 1- to 2-month periods to provide a general estimate of the relative waterfowl use of islands by season. These average populations are discussed to describe relative numbers and patterns of seasonal use on the islands, but they are not meant to be precise estimates of population use.

Waterfowl counts were converted to waterfowl use-day figures by multiplication of the monthly averages recorded on counts by the number of days per month. Waterfowl use determined from daytime surveys may not fully indicate the value of islands to waterfowl because many waterfowl feed at night, especially during the hunting season (Euliss and Harris 1987, Sacramento Valley Waterfowl Habitat Management Committee n.d., Connelly pers. comm.). Thus, use-day figures presented here may weight daytime resting use more than feeding use. Nonetheless, waterfowl use-day figures permitted easy comparison of use on the islands.

American coots and upland game species were counted during ground surveys. Species included in the upland game category are ring-necked pheasant, mourning dove, and California quail. No specialized surveys were conducted to estimate numbers of pheasants and doves.

Use of Other Data on Waterfowl Abundance in the Delta. No other systematic surveys of waterfowl

populations have been conducted on individual Delta islands. DFG mid-winter waterfowl survey data for the DW project islands were used to indicate long-term trends in waterfowl populations in the Delta. These data helped put the 1978-1988 survey data into a long-term perspective. In addition, data from DFG's records on birds collected during fowl cholera suppression programs and from single-species studies were used to supplement the results of 1987-1988 surveys on DW islands.

Habitat Use. Habitat types used by waterfowl on the DW project islands were recorded during aerial and ground surveys in 1987-1988. Use patterns were compared in a general way with the availability of habitat to assess relative habitat preferences by species. The habitat use evaluations represent only habitats used during the day when most waterfowl species are resting rather than feeding. Daytime use patterns, however, provide some indication of foraging habitat conditions because some individuals feed during the day (Miller 1987) and remain to rest in feeding areas, especially during nonhunting periods. Habitat use was assessed in the same manner for upland game as for general wildlife. Average abundances of species were compared at survey points among different dominant habitats.

Habitat Availability. Habitat availability on the four DW project islands was determined from vegetation maps (Chapter 3G, "Vegetation and Wetlands"). Availability of agricultural and wetland habitats on surrounding Delta islands was determined from a variety of sources (e.g., U.S. Fish and Wildlife Service [USFWS] 1978, DFG 1987a, Contra Costa County Department of Agriculture 1988, and San Joaquin County Office of the Agricultural Commissioner 1988).

Waste Grain Availability. The availability of waste grain on the DW project islands was determined through evaluation of food abundance in the field and its accessibility to waterfowl in the habitat evaluation procedures (HEP) modeling process (Chapter 3H, "Wildlife"). A substantial effort was made to evaluate the amount of waste corn available for use by waterfowl and other wildlife following harvest. Sampling was conducted during November 1988 on Bouldin Island and Webb Tract to determine pounds of corn left following harvesting. These two islands were used to represent intensive and nonintensive corn farming practices, respectively. Details of sampling are described in JSA (1989). Estimates of waste corn amounts (in pounds per acre) were multiplied by the corn acreages grown on each island (Chapter 3G, "Vegetation and Wetlands") to determine total postharvest grain amounts (in pounds). Effects of post-harvest disking on food abundance were also measured

through sampling of fields in November 1988, immediately after disking was completed.

No detailed effort was made to measure the changes in waste grain abundance during winter. Undisked fields on Bouldin Island were surveyed in March 1988 to determine late winter abundance of waste corn. A generalized evaluation of seasonal changes in grain availability was made from these data and from discussions with the DW project agricultural manager concerning patterns of sheep grazing, disking, and flooding.

Accessibility of food to birds is the other important habitat variable that affects foraging habitat value for waterfowl. Accessibility is determined by species preferences and abilities to use habitats with different water depths, vegetation densities, and levels of human disturbance. Details concerning assumptions and methods used to evaluate foraging habitat suitability for waterfowl are included in the DW project HEP report (JSA 1991).

Delta Region, Suisun Marsh, and San Francisco Bay

Information on waterfowl species in other areas of the Delta, Suisun Marsh, and San Francisco Bay was derived from conversations with regional waterfowl biologists and existing sources, especially USFWS (1978), DFG (1987a, 1987b), and Gilmer et al. (1982).

Special-Status Species

DW Project Islands

Special-status species with the potential to occur on the DW project islands were identified as those species on agency special-status species lists having distribution and habitat requirements suggesting that they could be present on the DW project islands. Table H2-2 summarizes the legal status, seasonal presence in the Delta, and occurrence of special-status species on the DW project islands and habitat potential for these species on each island. Information on species occurrence on the islands was derived from field surveys, review of DFG's Natural Diversity Data Base (NDDB), other literature, and unpublished information. Details concerning species occurrence and habitat quality are summarized below for each island.

Special-status species were surveyed using several methods. Methodologies were developed in consultation with DFG species experts and other staff members. Systematic ground surveys for general wildlife species

were used to inventory several special-status species, including greater sandhill crane, Aleutian Canada goose, Swainson's hawk, northern harrier, bald eagle, and peregrine falcon. Aerial and ground surveys for greater sandhill cranes were also conducted on Bouldin Island during 1988, 1989, and 1990. Specialized surveys were conducted for special-status species that were not likely to be detected during the systematic ground surveys. The specialized surveys consisted of intensive surveys of suitable habitat for the valley elderberry longhorn beetle (VELB), California black rail, tricolored blackbird, and giant garter snake.

Habitat suitability for VELB was evaluated through searches for elderberry shrubs on the four DW project islands during regular wildlife ground surveys and during special searches. Each elderberry plant detected was searched for VELB exit holes. Dense marsh habitat for the California black rail on Holland and Webb Tracts was surveyed through use of tape-recorded calls of black rails being played to elicit responses from territorial birds (Manolis 1977). Searches for tricolored blackbirds were conducted in dense wetlands and nearby shrub thickets. Substantial effort was spent surveying for the giant garter snake on each island. All suitable habitat (densely vegetated marshes and ditches) was surveyed on foot for 4 hours at midday for basking snakes. Surveys were conducted on 6 days during May and July. Special-status species were also looked for during other fieldwork conducted on the islands.

Delta Region, Suisun Marsh, and San Francisco Bay

Information on special-status species in other areas of the Delta, Suisun Marsh, and San Francisco Bay was derived from conversations with regional biologists and existing sources, especially USFWS (1978), DFG (1987a, 1987b), and Gilmer et al. (1982).

SURVEY RESULTS

General Wildlife Species

Table H2-3 shows average numbers of birds observed per station and per survey on each of the DW project islands by nine species groups. Birds observed per station is a measure of relative abundance per unit area of habitat. Birds observed per survey indicates relative abundance of species groups on islands overall. These data are useful for comparisons of bird abundance among the four project islands and among species groups. Con-

sequently, bird abundance was rated as low, moderate, or high for each DW project island based on a comparison of numbers of birds observed during surveys conducted on each island.

Table H2-4 lists wildlife species expected to occur on the DW project islands. The list includes common and scientific names and notes species observed in field surveys. Table H2-5 shows relative abundances of all bird species observed in ground surveys. Table H2-6 presents the habitat types on the DW project islands and describes the dominant or typical plant species associated with each habitat.

Bacon Island

Wildlife Habitats. Bacon Island is the most intensively farmed of the four project islands (see Chapter 3G, "Vegetation and Wetlands"). In December 1987, more than 80% of the land area (4,439 acres) on the island was farmed, mostly for potatoes and asparagus. The diversity and density of wildlife species supported by the island were found to be moderate compared with those of the other DW project islands (Tables H2-3 and H2-5). Only 14% of the area (776 acres) was planted in grain, all of which was corn, and 6% (355 acres) was fallow. The island also supported moderate amounts of herbaceous vegetation (528 acres, or 9%) and small amounts of freshwater and exotic marsh habitat (33 acres, or 0.6%) and riparian scrub habitat (3 acres, or 0.06%).

General Wildlife Abundance. Overall, low to moderate populations of most general wildlife species were detected on Bacon Island (Table H2-3). Numbers of gulls observed were higher than on the other project islands (average of 350 per ground survey); the gulls congregated in areas flooded for weed control in winter and spring. No breeding by gulls or terns was observed, and no suitable habitat was present during the nesting period for these species.

Moderate numbers of raptors were observed on Bacon Island, including an average of six American kestrels, five red-tailed hawks, and two black-shouldered kites per visit (Table H2-5). Moderate numbers of shorebirds were observed, nearly all of which were sandpipers. Moderate numbers of wading birds were observed during ground surveys, including an average of four great egrets, three snowy egrets, and two great blue herons per survey (Table H2-5); no nesting occurred on the island, and no potential nesting habitat existed. Few piscivorous (i.e., fish-eating) birds or birds of riparian areas, open water, or grasslands were observed on the island.

Webb Tract

Wildlife Habitats. Webb Tract is less intensively farmed than Bacon Island or Bouldin Island but supports more agriculture than Holland Tract. In 1987-1988, nearly half the island was farmed for corn (2,223 acres, or 41%) and wheat (445 acres, or 8%). Fifteen percent (839 acres) of the island supported herbaceous upland vegetation, 14% (783 acres) was exotic marsh that has invaded wet agricultural areas, and 12% (638 acres) was fallow agricultural land. Approximately 105 acres (3%) of open-water habitat exist at two blowout ponds. Most of the 106 acres of riparian woodland and scrub and 172 acres of freshwater marsh on Webb Tract surround these ponds.

General Wildlife Abundance. Determination of general wildlife species abundance through ground surveys was hampered because a former landowner denied access to a 643-acre area on the eastern portion of the island during the 1988 survey period. This area includes a large blowout pond and supports high-quality wetland, riparian woodland, and open-water habitats. Thus, the abundances of general wildlife species reported from systematic survey data for Webb Tract reflect only the species on the accessible portions of the island (Table H2-3). Wildlife use of the parcel to which access was denied was determined from aerial surveys, reconnaissance surveys conducted in June 1990, and information acquired from other similar habitats on Webb Tract and other islands.

The numbers of wading birds observed on Webb Tract were high relative to those observed on the other DW project islands (Table H2-3). The average number of herons and egrets recorded per survey station on Webb Tract was more than twice (0.9) the number recorded on Bacon Island and four times the numbers recorded on the other islands. An average of 20 wading birds per survey were observed on the surveyed portion of the island; these included 14 great egrets, three cattle egrets, and two great blue herons.

Most wading birds were found in the weedy marshland area on the north side of the island. An average of 3.6 wading birds per aerial survey were seen during May, but the birds presumably nested on adjacent islands; no nesting colonies were found during aerial, ground, and boat surveys of all potential nesting habitats conducted during the nesting season.

Higher numbers of raptors were seen on Webb Tract than on the other islands; however, the numbers were only slightly higher there than on Holland Tract (Table H2-3). The most common raptor species were black-

shouldered kite (average of 24 birds per survey), red-tailed hawk (13), and American kestrel (four) (Table H2-5). Numbers of raptor individuals recorded during May were substantially lower than those recorded in winter surveys, but the three most common species continued to use the island during this period and may have bred on the island.

Moderate numbers of riparian and wetland birds were observed on Webb Tract, but the numbers recorded during systematic surveys were undoubtedly low because of the lack of access granted to the eastern portion of the island. The most common riparian species observed in these surveys were white-crowned sparrow (average of 88 per survey), house finch (33), and song sparrow (10). Moderate numbers of grassland and agricultural birds were observed, including American crow (17), lesser goldfinch (27), and loggerhead shrike (four). Typical riparian species observed during the June 1990 survey of the eastern portion of the island were black-headed grosbeak, downy and Nuttall's woodpecker, rufous-sided towhee, and northern oriole (Table H2-5).

Small numbers of other species groups were observed during surveys, including piscivorous birds (average of seven individuals per survey), shorebirds (less than one per survey), gulls and terns (22), and blackbirds (12) (Tables H2-3 and H2-5). No swallows were observed.

Bouldin Island

Wildlife Habitats. Wildlife habitats on Bouldin Island are dominated by agricultural lands that in December 1987 supported corn (2,459 acres, or 41% of land area), wheat (1,183 acres, or 20%), and sunflower (888 acres, or 15%). Smaller amounts of other habitats existed, including fallow agricultural land (712 acres, or 12%) and herbaceous upland (349 acres, or 6%). Habitats present in more limited amounts were freshwater and exotic marsh (136 acres, or 2%), open water (118 acres, or 2%), riparian woodland and scrub (16 acres, or 0.3%), and woody non-native habitat (5 acres, or 0.1%).

General Wildlife Abundance. Low to moderate numbers of most bird species groups were observed on Bouldin Island during field surveys in 1987 and 1988 (Table H2-3). High numbers of gulls were observed, with an average of 340 seen per survey; no terns were seen, and no breeding habitat for gulls was present on the island. High numbers of grassland and agricultural birds, primarily American crows, were present. Blackbirds were also abundant.

Moderate numbers of raptors were observed on Bouldin Island, including an average of nine red-tailed hawks, six black-shouldered kites, five American kestrels, and two rough-legged hawks per survey. The number of raptors decreased in spring; the only non-special-status raptor species observed during the May survey was the red-tailed hawk, but the species did not nest on the island. Moderate numbers of swallows, mostly cliff swallows, were using Bouldin Island.

Small numbers of wading birds, shorebirds, and riparian and marsh birds were observed. An average of six wading birds per ground survey were seen, consisting of four great egrets and two great blue herons. No herons or egrets nested on the island. An average of only two shorebirds (both killdeer) per ground survey were seen. The most common riparian birds were the white-crowned sparrow (average of 24 birds per survey), house finch (18), song sparrow (six), American robin (three), and black phoebe (two).

Holland Tract

Wildlife Habitats. Holland Tract is the least intensively farmed of the four project islands. In 1987-1988, agriculture accounted for approximately 36% of the island acreage (1,541 acres), including nearly 6% (238 acres) planted in corn and 21% (880 acres) in wheat. Eighteen percent (785 acres) of the island was fallow, and 13% (560 acres) was pasture.

In December 1987, Holland Tract supported about 290 acres (7% of the island) of herbaceous wetland, mostly dominated by weedy species that had invaded fallow agricultural areas. Also, the northeast end of the island contained a 15-acre blowout pond formed by a levee failure in 1980. The blowout pond is surrounded by about 40 acres of riparian woodland and scrub vegetation and 18 acres of freshwater marsh. In total, the island supported about 120 acres (3%) of woody riparian vegetation, more than was supported by any of the other project islands. In 1987, DW constructed a shallow 63-acre demonstration wetland pond to evaluate vegetation establishment and growth under operating conditions of the original DW proposed project.

General Wildlife Abundance. The numbers of shorebirds, raptors, riparian and marsh birds, and black-birds and starlings observed at Holland Tract were high relative to the numbers observed on the other DW project islands (Table H2-3). The most common raptors were the black-shouldered kite and red-tailed hawk, both of which averaged 19 birds per survey. Raptors were most common in winter and declined to small numbers in April

(eight birds) and May (three birds); a red-tailed hawk nest was found, and kites were suspected to have nested on the island.

Shorebirds used the Holland Tract demonstration wetland and included an average of 60 sandpipers and 14 dowitchers observed per survey; no nesting by shorebirds was observed. The most common riparian birds observed were the house finch (200 birds per survey), American robin (20), song sparrow (19), and white-crowned sparrow (15). Large numbers of yellow-headed blackbirds (223 per survey) and red-winged blackbirds (214) were observed during winter; blackbird numbers declined during spring, but red-winged blackbirds remained and nested in weedy and marsh areas. Small numbers of starlings (13 per survey) were present.

Moderate numbers of gulls, grassland birds, and swallows (Table H2-3) were observed at Holland Tract during winter. Wading birds were less abundant on Holland Tract than on the other DW project islands, with an average of two great egrets, one snowy egret, and less than one great blue heron seen per survey.

Delta Region, Suisun Marsh, and San Francisco Bay

Delta Region. The island area of the Delta consists of approximately 600,000 acres on 60 islands. Most of this land (530,000 acres) is farmed, but about 44,000 acres are unfarmed upland; 7,000 acres support riparian woodland and scrub, and another 7,000 acres consist of freshwater marsh (Madrone Associates 1980, DFG 1987a).

A variety of crops is grown in the Delta region. Dominant crop types in winter in the south Delta in 1989-1990 were corn, winter wheat, barley, and irrigated pasture. Major crops in the north Delta were irrigated pasture, winter wheat, alfalfa, and orchards.

At least 230 species of birds and 43 species of mammals are found in the Delta (DFG 1987a). The area provides habitat of importance to shorebirds in particular. Thousands of shorebirds use fields flooded for weed control in late summer and fall and fields that flood shallowly from seepage and rainfall in winter.

General wildlife species reported from the Delta are similar to those described for the DW project islands. Wildlife species and populations on different islands vary primarily according to the amounts and types of crops grown and amounts of natural habitats remaining. Rollins (1977) rated the values of several Delta habitats along the proposed route of the Peripheral Canal from

most to least valuable. These habitats were riparian woodland, marsh, permanent pasture, cornfields, and asparagus fields.

Suisun Marsh. Suisun Marsh lies between San Francisco Bay and the Delta. The area provides approximately 57,300 acres of wetland and adjacent upland habitat and 27,000 acres of bays and waterways for use by waterfowl and other species (USFWS 1978). Approximately 45,700 acres are managed as private hunting clubs. Suisun Marsh is intensively managed to control salinity levels and to maintain waterfowl breeding and feeding habitat. Suisun Marsh also supports a variety of general wildlife species characteristic of saltwater and freshwater marsh and herbaceous upland areas.

San Francisco Bay. San Francisco Bay, as discussed in this appendix, includes Suisun, Grizzly, Honker, and San Pablo Bays and encompasses approximately 435 square miles. The area includes 53 square miles of tidal marsh, 15 square miles of diked marsh, and 55 acres of diked ponds (JSA et al. 1979). The condition of the habitat of the bay and marsh wetland is determined by several environmental factors, including elevation (hence, total inundation frequency and depth) and salinity.

San Francisco Bay habitats support about 200 species of birds and 40 species of mammals (DFG 1987b). Important groups include waterfowl and special-status species, which are discussed in subsequent sections. The bay supports hundreds of thousands of shorebirds during the migratory and winter seasons (Yee et al. 1988). Many nongame birds and mammals use the various marsh habitats.

Waterfowl and Upland Game

Long-Term Trends in Waterfowl Abundance in the Delta

Waterfowl populations wintering in the Delta fluctuate between years because of changes in weather, habitat conditions, and flyway populations. Despite annual fluctuation, high populations of waterfowl have used the Delta area in most years until the 1980s. A graph of mid-winter survey results during 1970-1990 shows changes in population levels (Figure H2-1).

During 1970-1980, waterfowl using the area exceeded 500,000 birds in 8 of 11 years and averaged 553,000 birds per year over the period. In the subsequent 10 years, numbers have never exceeded 216,000 birds and averaged 96,000 birds per year. Based on this

average, wintering waterfowl populations in the Delta are estimated to have declined by approximately 83% since the 1970s. The decline was most pronounced for ducks, but substantial declines are also evident for swans and geese. Duck and goose populations have begun to recover in recent years. The wet years of 1993 through 1995 in northern breeding areas provided favorable breeding conditions that resulted in substantially higher production of ducks and geese. Wintering populations of ducks and geese in the Delta and Central Valley, however, are still substantially smaller than the average wintering populations for the previous 40 years (Yparraguirre pers. comm.).

Population declines in the Delta reflect the larger waterfowl population decline that has occurred in the Central Valley and Pacific Flyway as a whole. The decline is attributable to a variety of factors, the most important of which are probably the prolonged drought in northern breeding areas and resulting unfavorable land use changes (i.e., intensified farming of former wetland areas and adjacent nesting habitats). Loss of winter habitat is also considered an important factor that has contributed to the population reduction and may prevent future recovery of populations. (Implementation Board of the Central Valley Habitat Joint Venture 1990).

Analysis of past population trends is relevant to the DW project because the populations recorded in 1987-1988 were approximately 80% smaller than those that likely occurred in the 1970s. The net result is that numbers of waterfowl reported for individual DW project islands in the following sections are lower than the historical numbers and are lower than the numbers of waterfowl that would probably be present if population recovery meets management goals. Nonetheless, the survey results provide a valuable indication of the relative abundance of waterfowl on the different DW project islands and indicate habitats used by species.

Habitat Availability

Four habitat types mapped on the DW islands represent potential agricultural land that was not tilled cropland in December 1987: exotic marsh (i.e., portions of agricultural fields that could not be tilled because of high water tables and that are occupied by hydrophytic [water-loving] weedy plants), annual grassland, exotic perennial grassland, and short-term fallow agricultural fields (see Table H2-6 for descriptions of habitat types). On the four DW project islands, approximately 5,960 acres (28% of the four-island acreage) consisted of these four types in December 1987.

This proportion of potential but untilled agricultural land on the DW project islands was higher than on most other Delta lands because of the low intensity of drainage management and agricultural operations on Holland and Webb Tracts in December 1987 as a result of previous island flooding in 1980. Bacon and Bouldin Islands, with 18% untilled land in December 1987, represented more typical presence of these habitat types on agricultural lands. This percentage is consistent with the percentage for Sacramento County as a whole, where in 1988, 31,710 acres were fallow agricultural land in three types of set-aside programs (Skinner pers. comm.), constituting 17% of the county's total agricultural cropland acreage.

Assuming total Delta agricultural acreage to be 531,200 acres (Madrone Associates 1980) and the proportion of untilled agricultural land in the Delta to be 18%, the Delta-wide area of the four nontilled agricultural habitat types could thus be approximately 95,600 acres. The portion of these four types on the DW project islands would thus be about 6% of the total Delta-wide acreage.

Bacon Island

The estimated number of total use-days by waterfowl on Bacon Island in 1987-1988 was moderate relative to the number of use-days on the other DW project islands (Table H2-7).

Swans. Tundra swans were observed using Bacon Island more than any other island except Webb Tract during the survey period (Table H2-7), with an average observed population of about 300 birds (Table H2-8). Swans were recorded from the start of surveys in December until late February. Nearly 90% of the swans were in cornfields flooded for weed control (Table H2-9); flooded cornfields made up less than one-third of the island's area.

Geese. The number of use-days by geese on Bacon Island was moderate compared with the number on the other DW project islands in 1987-1988 (Table H2-7). White-fronted geese arrived in substantial numbers in mid-December to late December. The population varied substantially in day-to-day abundance, with a high count of 920 birds during aerial surveys in early April. White-fronted geese were observed in flooded and unflooded agricultural fields (Table H2-9). Snow goose populations also varied widely; a peak population of 4,500 birds was seen in late March, but no birds were seen during 14 of the 18 surveys. All snow geese on Bacon Island were seen in unflooded, undisked agricultural fields. No Canada geese were seen on Bacon Island.

Ducks. Few ducks were observed on Bacon Island (Table H2-7). The highest number of ducks observed during aerial counts was 400 birds in early February, but the average number during December through March was less than 100 (Table H2-8). Flocks of about 200 pintails were seen twice in flooded potato fields. Mallards were seen in flooded fields and ditches (Table H2-9). Only 10 mallards were seen during May flights, indicating that few birds breed on the island.

Coots. Coots were fairly common on Bacon Island, with about 40 birds seen per ground survey. The birds used flooded cornfields and disked potato fields.

Upland Game. The numbers of ring-necked pheasant, California quail, and mourning dove observed on Bacon Island were low compared with the numbers observed on the other DW project islands (Table H2-10). Relative abundances of different upland game birds on Bacon Island are not readily comparable because the survey methods and timing resulted in underestimates of pheasant numbers. Nonetheless, the survey results are useful for comparing relative abundances of species between islands.

The number of pheasants observed on Bacon Island in 1987-1988 was lower than the numbers observed on the other DW project islands presumably because Bacon Island is farmed most intensively and cover is scarce. Only one quail covey and several doves were observed. One desert cottontail rabbit was seen during surveys.

Waste Grain Availability. The amount of waste corn available to waterfowl on Bacon Island was moderate compared with the amount available on the other DW project islands. Corn was cleanly farmed, so losses per acre were assumed to be low and similar to those measured on Bouldin Island (Table H2-11). Approximately 82,000 pounds of corn were estimated to be available immediately after harvest, but postharvest disking for winter wheat planting on approximately half of the corn acreage reduced availability to approximately 67,500 pounds (Table H2-11).

Approximately 1,900 acres on Bacon Island were farmed for market and seed potatoes in December 1987; this was the only acreage of potatoes in Contra Costa and San Joaquin Counties. The 1,500 acres of market potatoes are not flooded; they are kept in a saturated soil condition for several weeks following harvesting to encourage rotting (Shimasaki pers. comm.). Therefore, these fields provide little food for waterfowl. The 390 acres of seed potatoes are harvested later and cannot be rotted because of cold temperatures; these areas probably provide valuable forage for waterfowl.

Hunting Harvest. No waterfowl or upland game are harvested on Bacon Island (Shimasaki pers. comm.) (Table H2-12).

Webb Tract

Results of the 1987-1988 surveys indicated that Webb Tract supported high numbers of waterfowl use-days (Table H2-7). Total waterfowl use observed on Webb Tract was 10 times higher than that on any of the other DW project islands.

Swans. Of the four project islands, Webb Tract had the largest corn acreage and supported the highest numbers of swans during the midwinter survey period (Table H2-8). The average number observed in December and January was 1,100, with a peak number of 2,150 birds. Numbers declined to 30-170 individuals in February, and no birds were seen after early March. Swans on Webb Tract used both unflooded cornfields (69% of observed birds) and flooded fields (31%) (Table H2-9).

Geese. Webb Tract had the highest number of geese of the four project islands during aerial surveys (Table H2-7). Average numbers of white-fronted geese were 530 in December and January; 1,600 in February and March; and 1,900 in April (Table H2-8). The peak number for white-fronted geese was 3,700 birds in late April. No geese were observed during November 1988 surveys. Three-fourths of white-fronted geese were observed resting on the eastern blowout pond, with most other birds seen in undisked cornfields (Table H2-9).

The snow goose population averaged 4,700 during December through March, with a peak of 10,000 birds in mid-January (Table H2-8). Numbers declined at the end of March, with the April population averaging 470 birds. Ten to 20 birds remained through the last aerial survey in mid-May. Snow geese were usually seen resting on the eastern blowout pond but also were observed in undisked and flooded cornfields (Table H2-9).

Several groups of Canada geese were seen, the largest group consisting of approximately 650 birds in an undisked cornfield.

The survey data indicate that the eastern blowout pond on Webb Tract is an important resting area for geese in the Delta.

Ducks. Duck numbers observed at Webb Tract were also high (Table H2-7) but varied substantially over the survey period. Both mallards and pintails were seen regularly. Over 2,500 mallards were seen on November

1, 1988. A peak population of 20,000 ducks (both pintails and mallards) was found resting on the eastern blowout pond in mid-December. The average number for December and January counts was 5,400 birds. After mid-January, duck numbers declined substantially, averaging 240 per survey in February-March and 150 in April (Table H2-8). Nearly all ducks on Webb Tract observed during winter were found resting on the eastern blowout pond (Table H2-9).

Twenty-seven mallards seen during each of the two May surveys were assumed to be breeding birds and indicated a breeding population of perhaps 20-50 pairs. Only 10 mallards (some of which may have been young-of-year) were observed on the eastern Webb Tract lake during the June 1990 survey.

Coots. Few coots were seen on Webb Tract. Twelve birds were recorded during one aerial survey, and an average of seven birds were seen during ground surveys.

Upland Game. Webb Tract surveys recorded the highest numbers of mourning doves among the four DW project islands, moderate numbers of pheasants compared with numbers observed on the other DW project islands, and no quail (Table H2-10). The high number of doves presumably reflected the abundance of woodland perching sites and availability of grain in wheat fields in 1987-1988. Pheasant numbers were expected to be higher based on the abundance of grainfields and cover; reasons for the low numbers are unknown but may reflect low-intensity survey effort. Similarly, quail were expected to be more abundant because of the availability of dense cover.

Waste Grain Availability. Webb Tract produced large amounts of waste grain available for waterfowl and other wildlife. More than 2,200 acres were farmed for corn on the island. Losses of grain during harvesting were substantially higher on Webb Tract than on Bouldin Island; field sampling determined harvesting losses of approximately 250 pounds of corn per acre that would be available for waterfowl immediately after harvest (Table H2-11). Together, the large acreage and higher loss rates yielded a total availability of approximately 567,000 pounds of corn.

Wheat occupied 445 acres on Webb Tract. No measurements of food availability were made in wheat fields. Wheat provides seed following harvest in summer and green forage for geese and other wintering birds during late fall and winter.

Hunting Harvest. Harvest rates of ducks, geese, and pheasants were highest on Webb Tract among the four

project islands (Table H2-12). The harvest represents a small proportion of the total numbers of birds using the island.

Bouldin Island

Estimated waterfowl use-days on Bouldin Island calculated from 1987-1988 surveys were moderate compared with use-days on the other DW project islands (Table H2-7).

Swans. Swans arrived on Bouldin Island during November, December, and January, when an average of 310 birds were observed. Numbers declined subsequently, and no swans were found after the middle of February (Table H2-8). Overall, swan use of Bouldin Island was moderate compared with use of the other DW project islands (Table H2-7). Most swans (71%) were seen in flooded grainfields, with fewer numbers (27%) in undisked grainfields (Table H2-9).

Geese. The number of geese using Bouldin Island was low to moderate compared with the numbers using the other DW project islands (Table H2-7), and daily populations varied substantially over winter. Moderate numbers of white-fronted geese were seen during aerial surveys, with averages of 180-300 birds observed during various count periods from December through April (Table H2-8); the highest count was 1,100 birds in early January. Most white-fronted geese (59%) were seen in flooded, disked grainfields and undisked grain stubble (24%) (Table H2-9).

Snow geese were observed during only two of 21 aerial surveys of Bouldin Island; 250 birds were seen in early January in a flooded, disked field, and 500 birds were found in corn stubble in late March. Canada geese were seen in small numbers (fewer than 100) in disked and undisked fields during only two aerial surveys in mid-January and late March (Tables H2-8 and H2-9). Several flocks of Canada geese, including a group of 400, were seen in grazed fallow fields during ground surveys. Canada geese may have been slightly undercounted during aerial surveys because they were not easily distinguishable among larger groups of white-fronted and snow geese.

Fowl cholera records show variability in the use of Bouldin Island by geese. In 1986, DFG personnel collected 2,000 dead white-fronted and snow geese, which represented only a portion of the birds using the island at that time (DFG file information).

Ducks. Overall duck use observed at Bouldin Island was low (Table H2-7). Ducks were abundant in November to December, with a peak of 2,500 birds observed in late December (Table H2-8). The number of ducks observed declined substantially in early January and thereafter never exceeded 100 birds. Pintails were the most abundant duck, with more than 750 seen in late November. Mallards were identified in ditches and flooded fields (Table H2-9). Only four mallards were seen in May, indicating a very small breeding population.

Coots. No coots were observed during aerial surveys, but on average, 30 birds were seen during ground surveys at Bouldin Island. The birds used flooded fields and ditches.

Upland Game. Bouldin Island supported moderate numbers of ring-necked pheasants and mourning doves during the surveys; no quail were seen on the island (Table H2-10). Despite the abundance of cornfields and wheat fields for feeding, pheasant numbers were probably limited by the lack of cover on most parts of the island.

Waste Grain Availability. Bouldin Island produces a large amount of waste grain for waterfowl use. Corn grown on nearly 2,500 acres was the major grain crop in 1987-1988. Average corn availability shortly after harvest was 87 pounds per acre (Table H2-11). Field measurements on the island yielded an average of 106 pounds per acre of grain left in the half of the cornfields that were not disked after harvest and 68 pounds per acre in remaining areas disked prior to being planted in winter wheat (JSA 1989) (Table H2-11).

Wheat was another important crop on Bouldin Island in 1987-1988, occupying nearly 1,200 acres. Waste grain left following wheat harvest was not measured but was estimated for modeling in the HEP analysis. Wheat fields are harvested during summer, grazed by sheep in fall, flooded during winter, and replanted with corn in spring. Approximately half the corn acreage is replaced with wheat following harvest in fall. Waterfowl, especially Canada and white-fronted geese, graze extensively on green wheat forage during winter and early spring (Fredrickson et al. 1988, Miller pers. comm.).

Hunting Harvest. Small numbers of ducks, geese, and pheasants are harvested annually by hunters on Bouldin Island (Table H2-12). Harvested birds represent only a small proportion of the total number of birds using the island.

Holland Tract

Estimated total use-days by waterfowl on Holland Tract in 1987-1988 were low (Table H2-7).

Swans. Few tundra swans were observed on Holland Tract (Table H2-8). Swans were first observed in late November; the average number of tundra swans from December 1987 to March 1988 was 10, with a peak population of 33 birds in mid-February (Table H2-8). A total of 184 swans were seen on December 29, 1988. Nearly all birds were detected in flooded fields (Table H2-9).

Geese. Few geese were observed using Holland Tract (Table H2-7). White-fronted geese were seen during four of 21 winter 1987-1988 aerial surveys; none were seen during the November-December 1988 surveys. Few or no white-fronted geese were seen during November to March, but numbers increased to an average of 210 during April (Table H2-8). Snow geese were not recorded on Holland Tract during aerial surveys, but 2,000 birds were seen feeding in an unharvested field of corn near the blowout pond during a ground survey in early February.

Several small flocks of Canada geese were seen during December and January, with the largest flock numbering 40 birds; only three birds were subsequently observed. Nearly all Canada geese recorded during Holland Tract surveys were flying and may not have landed on the island.

Ducks. Holland Tract supported moderate numbers of ducks during the 1987-1988 surveys (Table H2-7). Duck numbers were similar throughout the 1987-1988 survey period (Table H2-8). Mallards were seen in flocks of up to 120 birds; most birds were found in the demonstration wetland and the blowout pond, and the rest were observed in flooded fields (Table H2-9). An average of 100 ducks were seen at the demonstration wetland during the ground surveys in February-May 1988; species seen at the demonstration wetland (and average numbers per survey) included American widgeon (28), mallard (18), northern pintail (18), cinnamon teal (14), ruddy duck (12), and northern shoveller (eight).

Surveys were also conducted at the demonstration wetland during January-March 1989, following the raising of water levels to a 4-foot maximum depth. An average of 1,000 ducks and 200 coots were observed per survey on the 63-acre pond (Table H2-13).

Coots. Approximately 300 coots were seen per ground survey at Holland Tract. Most birds were found

at and around the demonstration wetland. Miller (pers. comm.) also reported extensive use of other areas of the island during winter.

Upland Game. Pheasants and quail were more abundant on Holland Tract than on the other three DW project islands (Table H2-10). The higher populations presumably resulted from the greater amounts of cover provided for pheasants by fallow areas and for quail by riparian shrubs and trees. Mourning dove populations were also high, presumably because of the abundance of perching sites in trees.

Waste Grain Availability. Holland Tract produced a moderate amount of waste grain for waterfowl (Table H2-11). Wheat was the major crop, consisting of 880 acres. As modeled in the HEP analysis (Chapter 3H, "Wildlife"), wheat provides seed during spring and late summer for resident species and green forage for wintering species, especially geese. A small acreage of corn (240 acres) was grown on Holland Tract in 1988. Corn harvesting was considered nonintensive, and loss rates were estimated as being similar to those measured on Webb Tract (Table H2-11).

Hunting Harvest. Few ducks, geese, and pheasants are harvested annually by hunters on Holland Tract (Table H2-12). The estimated harvest represents only a small proportion of the total populations using the island.

Delta Region, Suisun Marsh, and San Francisco Bay

The Delta supports nearly 10% of the waterfowl that winter in the Pacific Flyway. The Delta provides important waterfowl habitat on flooded and unflooded agricultural lands, natural wetlands, and sloughs. Approximately 12,000 acres of agricultural lands are flooded by duck clubs in the Delta (USFWS 1978).

Information on historical and current waterfowl populations in the Delta region was presented earlier in this section. During the 1970s, wintering waterfowl populations in the Delta averaged 553,000 birds (DFG 1987a). Numbers of ducks have declined substantially throughout the flyway since then; swan and goose populations have also declined but not as precipitously.

Several waterfowl species are particularly dependent on the Delta. Nearly 75% of all tundra swans and more than one-third of all white-fronted geese in the Central Valley winter in the Delta (DFG 1987a). Recent radio-telemetry studies of white-fronted geese have indicated that birds in the Delta spend approximately 70% of their time in cornfields during fall and early winter and roost

only on several water bodies, one of which is the eastern Webb Tract blowout pond (Takekawa pers. comm.). The Delta also supports large populations of snow geese, pintails, and mallards (Gilmer et al. 1982, DFG 1987a).

Suisun Marsh contains more than 57,000 acres of managed wetland and upland. Substantial numbers of waterfowl use Suisun Marsh. The highest use occurs during early fall before the onset of rains, when the availability of shallow-water habitat attracts waterfowl. Suisun Marsh supported up to 10% of the waterfowl in California's Central Valley during the mid-September surveys in 1973-1976. Waterfowl populations in Suisun Marsh decline later in winter, when additional flooded habitat is available. Suisun Marsh supported approximately 2% of the waterfowl population observed during the midwinter surveys in December 1973-1976. (USFWS 1978.)

Increases in salinity from past water diversions have altered habitats in Suisun Marsh. Changes in vegetation and aquatic communities generally have been detrimental to dabbling ducks. The Suisun Marsh salinity control gate was recently installed in Montezuma Slough to control salt water intrusion and maintain waterfowl habitats in Suisun Marsh (California Department of Water Resources [DWR] 1984).

San Francisco Bay provides important habitats for wintering waterfowl (DFG 1987b). The saltwater portions of the bay support a large proportion of the diving ducks wintering in California. Freshwater and brackish areas in the eastern portion of the bay provide important habitats for dabbling ducks (e.g., mallards and northern pintails) and geese.

Special-Status Species

Additional information regarding the status of the giant garter snake, bald eagle, Aleutian Canada goose, peregrine falcon, Swainson's hawk, and greater sandhill crane on the DW project islands is presented in Appendix H3, "Federal Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Wildlife Species", and Appendix H4, "California Endangered Species Act Biological Assessment: Impacts of the Delta Wetlands Project on Swainson's Hawk and Greater Sandhill Crane".

Bacon Island

Northern harrier and burrowing owl were the only special-status species observed on Bacon Island, although potential habitat exists for several other special-status species.

Northern Harrier. The numbers of northern harriers observed on Bacon Island were low relative to the numbers observed on the other DW project islands. An average of five harriers were observed per survey in February and numbers subsequently declined; no northern harriers were seen in June (Table H2-14). Harriers probably do not nest on Bacon Island because nearly all the island is cultivated and suitable nesting sites are limited. Harriers, however, have been observed to attempt nesting in wheat fields in Yolo County. Harriers observed in spring could have been from adjacent islands or could have been nonbreeding birds.

Burrowing Owl. A burrowing owl was observed during the ground survey on February 23, 1988. No owls were seen in this area or elsewhere on subsequent surveys. Burrowing owls probably do not nest on Bacon Island because intensive agricultural practices and levee maintenance activities have minimized availability of suitable burrows and the presence of ground squirrels that provide burrows.

Other Potential Special-Status Species. Eleven additional special-status species could occur on Bacon Island: Swainson's hawk, tricolored blackbird, Aleutian Canada goose, greater sandhill crane, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, short-eared owl, giant garter snake, and California black rail. These species are discussed below.

Swainson's Hawk. No Swainson's hawks were observed during regular ground surveys, which included 13.5 hours spent on 4 days during late March to early August 1988. Swainson's hawks could forage on Bacon Island during migration or the breeding season. Fallow land, pasture, grassland areas, and areas of grain and row crops, which total 4,005 acres on Bacon Island, are suitable foraging habitats for Swainson's hawk. The island does not support suitable nesting habitat.

Intensive Swainson's hawk surveys were conducted in 1990 in an attempt to locate all nesting pairs in San Joaquin County. Additional surveys have been subsequently conducted. The nearest known nest site is immediately east of Bacon Island on Mildred Island (Wernette pers. comm.). Seven pairs are known to nest within 10 miles of the island (JSA 1991).

Tricolored Blackbird. No tricolored blackbirds or suitable nesting habitat were observed during winter and spring ground surveys on Bacon Island. Pasture, grassland, and grain crop habitats are suitable for foraging use by the tricolored blackbird at various seasons. Use of the island during the breeding season appears unlikely because the nearest known breeding colony is in Contra Costa County, 8.5 miles away (Beedy pers. comm.).

Other Wintering Species. Bacon Island supports suitable habitat for several special-status species that were not observed during the wildlife surveys but could occur irregularly during nonbreeding seasons. These species include Aleutian Canada goose, greater sandhill crane, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owl.

Other Breeding Species. Several special-status species not observed during ground surveys could breed at Bacon Island. No giant garter snakes were located during surveys of potential habitat. Bacon Island contains approximately 5 miles of ditch habitat that is considered marginal habitat for the giant garter snake because it lacks emergent or bank vegetation. Giant garter snakes are not expected to be found on the island (Littlefield pers. comm.). The nearest recorded observation is from White Slough, approximately 8 miles northeast of Bacon Island (Hansen and Brode 1980).

No emergent wetland or dense blackberry habitat suitable for nesting exists for the California black rail on Bacon Island. Several rails were heard calling in dense emergent vegetation under the Bacon Island Bridge on an adjacent natural island in Middle River in May 1988 (JSA 1988).

Webb Tract

Northern harrier was the only confirmed special-status species observed on Webb Tract.

Greater Sandhill Crane. One sandhill crane (subspecies not identified) was observed in December 1987 during an aerial survey on Webb Tract. Cranes could forage in fallow fields, grainfields, pastures, exotic marshes, and perennial grasslands.

Northern Harrier. The number of harriers supported in winter on Webb Tract was high relative to the numbers on the other DW project islands, with an average of 14 birds seen per survey in February. No birds were seen during the one survey in May (Table H2-14).

Harriers could nest in dense wetlands or fallow fields on the island.

Other Potential Special-Status Species. Thirteen additional special-status species could occur on Webb Tract: Swainson's hawk, tricolored blackbird, Aleutian Canada goose, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, short-eared owl, VELB, western pond turtle, giant garter snake, California black rail, and burrowing owl. These species are discussed below.

Swainson's Hawk. No Swainson's hawks were observed on Webb Tract during 13 hours of surveys on 4 days from late May to early August in 1988-1990. Nesting habitat is limited for the species because most trees on the island are too small to support nests. No nests were found during surveys of all potential habitat. Fallow habitat, pasturelands, grasslands, and agricultural fields, which total 5,015 acres on Webb Tract, provide suitable foraging habitat for Swainson's hawk. Some of the fallow areas, however, may be too tall and dense to be used for foraging by Swainson's hawks.

The nearest known nest site is approximately 4 miles north of Webb Tract, and seven pairs nest within 10 miles of the islands.

Tricolored Blackbird. Webb Tract provides suitable foraging and nesting habitat for the tricolored blackbird. No birds were observed, however, during surveys conducted during various seasons. No nesting colonies were found during surveys of suitable nesting habitat in 1988 and 1990, and no birds were seen foraging during the breeding or nonbreeding season.

Pasturelands, grasslands, fallow habitats, and harvested crops provide seasonal foraging habitats for the tricolored blackbird. The lack of observation of foraging birds during the nesting season may result from an absence of nearby nesting colonies. The nearest known colony is 13 miles southwest of Webb Tract at Marsh Creek Reservoir (Beedy pers. comm.). Available information and survey results indicate that the tricolored blackbird is not likely to be found regularly on Webb Tract during the breeding season. Tricolored blackbirds range widely during winter and could be present during nonbreeding periods.

Wintering Species. Webb Tract supports marginal habitat for the following nonbreeding special-status species that were not observed but could irregularly occur: Aleutian Canada goose, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owl.

Breeding Species. Webb Tract supports marginal habitat for several special-status species that were not observed but could breed there. No VELB habitat was found in surveyed portions of Webb Tract. Potential habitat for western pond turtles is provided by the blowout ponds; however, none were observed during surveys. Pond turtle upland nesting and estivation habitat is limited. No giant garter snakes were observed during extensive surveys on foot along ditches, canals, and the northern blowout pond. Webb Tract supported approximately 3 miles of moderately suitable giant garter snake habitat and less than 1 mile of marginal habitat along ditches and canals. Giant garter snakes are not expected to be found on Webb Tract (Littlefield pers. comm.). California black rails were not detected during extensive surveys at the northern blowout pond, which was considered marginal breeding habitat. Suitable California black rail habitat exists on natural islands in channels adjacent to Webb Tract; however, those areas were not surveyed.

No burrowing owls were observed during ground surveys. Burrowing owls probably did not nest at Webb Tract because previous intensive agricultural and levee maintenance activities on the island have eliminated suitable burrows and ground squirrels that provide burrows.

Bouldin Island

Greater sandhill crane, Swainson's hawk, and northern harrier were the only special-status species observed on Bouldin Island during the 1987-1988 survey. Since surveys were conducted, other special-status species have been observed, including peregrine falcon, Cooper's hawk, ferruginous hawk, and short-eared owl.

Greater Sandhill Crane. Sandhill cranes were regularly observed during October-February, but numbers subsequently dropped rapidly, and none were seen after March 7, 1988. Both greater and lesser sandhill cranes (*Grus canadensis tabida* and *G. c. canadensis*) were present on the island, but numbers of each subspecies were only recorded separately during ground surveys. All the cranes seen during one October visit were lesser sandhill cranes, but 95% of the birds identified to subspecies in February-March were greater sandhill cranes (Table H2-15). DFG has identified Bouldin Island as a greater sandhill crane wintering area (Wernette pers. comm.).

Swainson's Hawk. Surveys for Swainson's hawks were conducted for total of 18.5 hours on 4 days during late March to late May 1988. One Swainson's hawk was observed flying over the island on May 31, 1988. A

grove of cottonwoods on the north side of the island was a suitable nesting site for Swainson's hawks, but no nest was present. Pasture, fallow fields, and agricultural fields, which totaled 5,739 acres, provided suitable foraging habitat; some fallow areas, however, may be too tall and dense to be used for foraging by Swainson's hawks. The nearest known Swainson's hawk nest site is approximately 3 miles north of Bouldin Island. Ten pairs are known to nest within 10 miles of the island.

Northern Harrier. Bouldin Island supported moderate numbers of harriers, with monthly averages of four to 11 birds seen per survey in February to April; no birds were seen in May (Table H2-14). Harriers probably did not nest on Bouldin Island. Potential nesting habitat on the island is limited to wheat fields and dense vegetation along the levee toe because of intensive cultivation on bottomlands and sheep grazing on the fallow lands and levee slopes.

Other Potential Special-Status Species. Ten additional special-status species may occur on Bouldin Island: tricolored blackbird, Aleutian Canada goose, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, short-eared owl, giant garter snake, VELB, and California black rail. These species are discussed below.

Tricolored Blackbird. Bouldin Island does not support suitable nesting habitat for tricolored blackbird, but pastures and croplands are suitable foraging habitat for breeding and wintering birds. No tricolored blackbirds were observed during spring and summer 1988, and the nearest known breeding colony is 17 miles away, at Marsh Creek Reservoir in Contra Costa County (Beedy pers. comm.). This information suggests that the tricolored blackbird is unlikely to be found during the breeding season on Bouldin Island. Tricolored blackbirds range widely during winter and could be present during nonbreeding periods.

Other Wintering Species. Bouldin Island supports potential habitat for the following other special-status species that were not observed during the ground surveys; these species could occur irregularly during the nonbreeding season: Aleutian Canada goose, bald eagle, peregrine falcon, ferruginous hawk, Cooper's hawk, and short-eared owl.

No Aleutian Canada geese were observed at Bouldin Island, although other subspecies of Canada geese were observed. Aleutian Canada geese generally winter in two localized areas near Modesto and Colusa (Nelson et al. 1984). Thirty to 40 Aleutian geese were reported foraging in a harvested cornfield on Bouldin Island on Decem-

ber 7, 1983 (Nelson et al. 1984); no other observations have been reported.

No bald eagles were observed using Bouldin Island during the survey period; however, eagles could forage along the channels outside the island. Bald eagles, however, would not be expected to forage on the island because it lacks extensive open water. Peregrine falcons could irregularly hunt for shorebirds and waterfowl on the island. Peregrine falcons were observed on the island in 1991 and 1993 (Holt pers. comm.). Subsequent to the 1988 surveys, Cooper's hawks were observed in 1991, 1992, and 1993 (Estep and Holt pers. comms.), short-eared owls in 1992 (Estep pers. comm.), and ferruginous hawks in 1991 and 1993 (Estep pers. comm.).

Other Breeding Species. Bouldin Island also supports marginal habitat for three special-status species that were not observed during the ground surveys but could breed there. The island contains approximately 7 miles of ditches and canals that are marginal habitat for the giant garter snake, although none were observed. Giant garter snakes are not expected to be found on the island (Littlefield pers. comm.). The nearest recorded observation of the giant garter snake is at White Slough, approximately 4 miles east of Bouldin Island (Hansen and Brode 1980). No suitable VELB habitat (elderberry shrubs) or California black rail habitat (dense marsh) exists on Bouldin Island. Suitable California black rail habitat exists on natural islands in channels adjacent to Bouldin Island; however, these areas were not surveyed.

Holland Tract

Special-status species observed on Holland Tract were Swainson's hawk and northern harrier.

Swainson's Hawk. One adult Swainson's hawk was observed soaring over Holland Tract on April 18, 1988. This was the only observation of a Swainson's hawk on Holland Tract made during 35 hours of surveys for biological resources on 15 days during mid-March to mid-September in 1988-1990. Suitable nesting habitat on the island exists in trees over 25 years old, but no nests were found. Fallow areas, pasture, grassland, and agricultural fields, which totaled 3,296 acres in 1988 on Holland Tract, were suitable for foraging use by Swainson's hawks. The nearest known nest site is 9 miles east of the island, and seven sites are located within 10 miles.

Northern Harrier. Holland Tract supported at least four northern harriers throughout the survey period (Table H2-14). Harriers could have nested in dense wetlands or in fallow fields on the island.

Other Potential Special-Status Species. Thirteen additional special-status species may occur on Holland Tract: VELB, tricolored blackbird, Aleutian Canada goose, greater sandhill crane, bald eagle, peregrine falcon, Cooper's hawk, ferruginous hawk, short-eared owl, burrowing owl, western pond turtle, giant garter snake, and California black rail. These species are discussed below.

Valley Elderberry Longhorn Beetle. One large cluster of elderberry shrubs was located on the eastern levee. The VELB probably does not occur on the island. No VELB exit holes or adult beetles were detected in the shrubs. The nearest known recorded observation was made at Middle River near Stockton (NDDB 1990).

Tricolored Blackbird. Holland Tract provides suitable foraging and nesting habitat for tricolored blackbird. No tricolored blackbirds were observed, however, during more than 40 hours of surveying during various seasons on Holland Tract. No nesting colonies were found during a complete survey of suitable nesting habitat in 1988, and no birds were seen foraging during the breeding or nonbreeding season.

Pasturelands, grasslands, fallow habitat, and harvested crops provide suitable foraging habitats for the tricolored blackbird during various seasons. The lack of observation of foraging birds during the nesting season results from the probable absence of nearby nesting colonies. The nearest known colony is 8.5 miles southwest of Holland Tract at Marsh Creek Reservoir (Beedy pers. comm.). This information indicates that the tricolored blackbird is unlikely to be found regularly during the breeding season but could use the island in the nonbreeding season.

Other Wintering Species. Holland Tract supports marginal habitat for the following special-status species that were not observed but could occur irregularly during the nonbreeding season: Aleutian Canada goose, greater sandhill crane, bald eagle, peregrine falcon, Cooper's hawk, ferruginous hawk, short-eared owl, and burrowing owl.

Breeding Species. Holland Tract supports habitat for three special-status species that were not observed but could breed there: the western pond turtle, the giant garter snake, and the California black rail. The Holland Tract blowout pond provides suitable western pond turtle habitat. Western pond turtles have been reported in the blowout pond; however, none were observed during surveys. No giant garter snakes were observed during intensive searches along the ditches and canals and in the blowout pond. Giant garter snakes are

not expected to be found on the island (Littlefield pers. comm.). Holland Tract, however, supports approximately 2 miles of moderately suitable habitat and 4 miles of marginal habitat for the snake along ditches and canals. No California black rails were located during surveys of potential habitat at the blowout pond.

Delta Region, Suisun Marsh, and San Francisco Bay

The Delta is known to support seven birds, one reptile, and three insects state-listed or federally listed as threatened or endangered, and four birds, two mammals, one reptile, and two insects identified as federal candidates for listing (see Appendix H5, "Agency Correspondence regarding the Federal and California Endangered Species Acts"). The Delta area is used only irregularly by small numbers of peregrine falcons and bald eagles. The area is also on the fringe of the breeding range of several species, including California black rail and yellow-billed cuckoo. The Delta supports a small number of nesting Swainson's hawk pairs; densities are substantially greater on higher elevation lands north and east of the Delta (Estep pers. comm.). Certain localized areas of the Delta serve as important wintering habitat for greater sandhill crane (Pogson and Lindstedt 1988) and Aleutian Canada goose (Nelson et al. 1984).

Suisun Marsh and San Francisco Bay provide habitat for six bird species and one mammal listed as threatened or endangered by DFG or USFWS, and three birds and two mammals identified as federal candidates for listing (DFG 1987b). The salt marsh harvest mouse, California clapper rail, and, to a lesser extent, the California black rail occur primarily in salt marsh habitats. The salt marsh common yellowthroat and Suisun song sparrow subspecies prefer tall emergent vegetation that grows in more brackish conditions.

CITATIONS

Printed References

- California. Department of Fish and Game. 1987a. Testimony on wildlife in the Sacramento-San Joaquin Delta for the State Water Resources Control Board's Bay-Delta hearings. Bay-Delta Project. Sacramento, CA.
- _____. Department of Fish and Game. 1987b. Testimony on wildlife in the San Francisco Bay for the State Water Resources Control Board's Bay-Delta hearings. Bay-Delta Project. Sacramento, CA.
- _____. Department of Water Resources. 1984. San Joaquin County 1982 land use survey. Sacramento, CA.
- Contra Costa County Department of Agriculture. 1988. Contra Costa County agricultural report 1987. Concord, CA.
- Euliss, N. H., and S. W. Harris. 1987. Feeding ecology of northern pintails and greenwinged teal wintering in California. *Journal of Wildlife Management* 51(4): 724-732.
- Fredrickson, L. H., M. Laubhan, and A. Strong. 1988. Sherman Island wildlife management plan. California Department of Water Resources and California Department of Fish and Game. Sacramento, CA.
- Gilmer, D. S., M. R. Miller, R. D. Bauer, and J. R. LeDonne. 1982. California's Central Valley wintering waterfowl: concerns and challenges. *Transaction of the North American Wildlife and Natural Resources Conference* 47:441-452.
- Hansen, G. E., and J. M. Brode. 1980. Status of the giant garter snake, *Thamnophis couchi gigas* (Fitch). (Inland Fisheries Endangered Species Program Special Publication 80-5.) California Department of Fish and Game. Sacramento, CA.
- Implementation Board of the Central Valley Habitat Joint Venture. 1990. Central Valley habitat joint venture implementation plan. Ducks Unlimited. February. Sacramento, CA.
- Jones & Stokes Associates, Inc. 1988. Habitat type mapping: Bedford Properties Delta islands project. Final report. (JSA 87-119.) Sacramento, CA. Prepared for Bedford Properties, Lafayette, CA.
- _____. 1989. Availability of waste corn for waterfowl use at Delta Wetlands' islands in the Sacramento-San Joaquin Delta. (JSA 87-119.) Sacramento, CA. Prepared for Delta Wetlands, Lafayette, CA.
- _____. 1991. Habitat evaluation procedures (HEP) report for the Delta Wetlands project. Draft. (JSA 87-119.) Prepared for the California State Water Resources Control Board, Division of Water Rights, and the U.S. Army Corps of Engineers, Sacramento District. Sacramento, CA.

Jones & Stokes Associates, Inc.; Harvey & Stanley Associates, Inc.; and John Blaney Associates. 1979. Protection and restoration of San Francisco Bay fish and wildlife habitat. (JSA 77-046.) Sacramento, CA. Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game, Sacramento, CA.

Madrone Associates. 1980. Sacramento-San Joaquin Delta wildlife habitat protection and restoration plan. Novato, CA. Prepared for California Department of Fish and Game and U.S. Fish and Wildlife Service, Sacramento, CA.

Manolis, T. D. 1977. California black rail breeding season in central California. California Department of Fish and Game. Sacramento, CA.

Miller, M. R. 1987. Fall and winter foods of northern pintails in the Sacramento Valley, California. *Journal of Wildlife Management* 51(2):405-414.

Natural Diversity Data Base. 1990. Printout of records for Contra Costa and San Joaquin Counties, California. Sacramento, CA.

Nelson, E. T., P. F. Springer, and D. R. Yparraguirre. 1984. Population, distribution, and ecology of Aleutian Canada geese on their migration and wintering areas, 1983-1984. U.S. Fish and Wildlife Service. Arcata, CA.

Pogson, T. H., and S. M. Lindstedt. 1988. Abundance, distribution, and habitat of Central Valley population sandhill cranes during winter. University of Alaska, Department of Biology and Wildlife. Fairbanks, AK.

Rollins, G. L. 1977. The Peripheral Canal wildlife inventory. California Department of Fish and Game. Sacramento, CA.

Sacramento Valley Waterfowl Habitat Management Committee. n.d. Pacific Flyway waterfowl in California's Sacramento Valley wetlands: an analysis of habitat - a plan for protection. Appendix. National Audubon Society. Sacramento, CA.

San Joaquin County Office of the Agricultural Commissioner. 1988. San Joaquin County agricultural report 1987. Stockton, CA.

U.S. Fish and Wildlife Service. 1978. Concept plan for waterfowl wintering habitat preservation: Central Valley, California. Portland, OR.

Yee, D. G., R. A. Erickson, and S. F. Bailey. 1988. The spring season: middle Pacific coast region. *American Birds* 42(3):477-480.

Personal Communications

Baugh, Gene. Caretaker, Holland Tract. Delta Wetlands, Holland Tract, CA. February 16, 1989 - meeting.

Beedy, E. C. Wildlife biologist (tricolored blackbird authority). Jones & Stokes Associates, Inc., Sacramento, CA. October 3, 1990 - meeting.

Connelly, Daniel P. Waterfowl and upland game coordinator. California Department of Fish and Game, Sacramento, CA. October 1988 through January 1989 - meeting and telephone conversations.

Dinelli, Gerald. Webb Tract property owner. Antioch, CA. October 14, 1988 - telephone conversation; December 6, 1988 - meeting.

Estep, James. Wildlife biologist (Swainson's hawk authority). Jones & Stokes Associates, Inc., Sacramento, CA. October 5, 1990, and April 3, 1994 - meetings.

Frelier, Marc. Holland Tract property owner. Carmel Valley, CA. October 17, 1988 - telephone conversation.

Gifford, Dan. San Joaquin County unit biologist. California Department of Fish and Game, Stockton, CA. January 1988 - telephone conversation.

Holt, Waldo. Field biologist. Audubon Society, Stockton, CA. November 1991, December 1992, December 1993 - meetings in the field.

Littlefield, Mark. Wildlife biologist. U.S. Fish and Wildlife Service, Sacramento, CA. February 1, 1994 - telephone conversation.

Miller, Wendell. Consulting wildlife biologist. Smartsville, CA. January 23, 1988 - letter to John Winther; December 1988 through February 1989 - telephone conversations.

Shimasaki, Kyser. President. Rancho Del Rio Farms, Bacon Island, CA. August 23, 1988 - letter; October 5 and 14, 1988 - telephone conversations.

Skinner, Connie. County executive director. Agricultural Stabilization and Conservation Service, Sacramento, CA. February 2, 1990 - telephone conversation.

Takekawa, John Y. Research biologist. U.S. Fish and Wildlife Service, North Prairie Research center, Dixon, CA. March 28, 1988 - telephone conversation and unpublished data.

Wernette, Frank. Senior wildlife biologist. California Department of Fish and Game, Stockton, CA. November 3, 1989, October 14, 1993, and June 13, 1994 - memoranda to SWRCB.

Wilkerson, Clyde. Manager. Bouldin Island Farming Company, Isleton, CA. October 5 and 13, and November 18, 1989 - telephone conversations.

Yparraguirre, Dan. Waterfowl biologist. California Department of Fish and Game, Sacramento, CA. May 26, 1995 - telephone conversation.

Table H2-1. Survey Coverage by Stations and by Month for 1988
Systematic Wildlife Ground Surveys on the DW Project Islands

Island	Total Area (acres)	Surveyed Area (acres)	Number of Survey Stations	Average Number of Acres per Survey Station
Bacon	5,539	5,539	31	179
Webb	5,469	4,826 ^b	22	219
Bouldin	5,985	5,985	41	146
Holland ^a	4,249	4,249	22	193

Island	Number of Surveys per Month			
	February	March	April	May
Bacon	4	2	1	1
Webb	4	1	-- ^c	-- ^c
Bouldin	4	2	1	1
Holland ^a	4	2	1	1

^a Survey coverage includes the southwest quarter of Holland Tract, which is not included under Alternatives 1 and 2.

^b A parcel at the east end of Webb Tract was not surveyed in 1988 because of lack of access.

^c Webb Tract was not accessible in April and May 1988 because of ferry breakdown.

Table H2-2. Legal Status, Occurrence, and Habitat Use of Special-Status Species in the Delta Region and on the DW Project Islands

Species	Legal Status Federal/State ^a	Seasonal Presence in the Delta Region	Potential Habitat Uses on the DW Project Islands	Regular Occurrence and Habitat Quality							
				Bacon		Webb		Bouldin		Holland	
				Occurs Regularly? ^b	Habitat Quality ^c	Occurs Regularly? ^b	Habitat Quality ^c	Occurs Regularly? ^b	Habitat Quality ^c	Occurs Regularly? ^b	Habitat Quality ^c
Valley elderberry longhorn beetle	T/--	Year round	All	N	U	N	U	N	U	N	L to U
Western pond turtle	C2/SSC	Year round	All	N	L to U	P	L	N	L to U	Y	M
Giant garter snake	T/T	Year round	All	N	L to U	N	L	N	L	N	L
Aleutian Canada goose	T/T	Fall-spring	Feeding	N	M	N	L	N	M	N	L
Cooper's hawk	--/SSC	Fall-winter	Feeding/roosting	P	L to U	P	L	P	L to U	P	L
Ferruginous hawk	C2/SSC	Fall-winter	Feeding/roosting	P	L	P	L	P	L	P	M
Bald eagle	E/E	Fall-spring	Feeding/roosting	N	L	N	L	N	L	N	L
Northern harrier	--/SSC	Spring-summer	Breeding/feeding	N	U	Y	M	N	L	Y	M
		Fall-spring	Feeding	Y	M	Y	H	Y	M	Y	H
Swainson's hawk	--/T	Spring-summer	Breeding/feeding	N	L	P	M	P	M	N	M
Peregrine falcon	E/E	Fall-spring	Feeding	N	L	N	L	N	L	N	L
California black rail	C1/T	Spring-summer	Breeding/feeding	N	U	N	U	N	U	N	U
		Fall-winter	Feeding	N	U	N	L	N	U	N	L
Greater sandhill crane	--/T	Fall-winter	Feeding	N	L	P	L	Y	M	N	L
Burrowing owl	--/SSC	Year round	Breeding/feeding	P	L	N	L	N	L	N	L
Short-eared owl	--/SSC	Fall-winter	Feeding/roosting	P	L	P	M	P	L	P	H
Tricolored blackbird	C2/SSC	Spring-summer	Breeding/feeding	N	U	N	L	N	U	N	L
		Fall-winter	Feeding	P	M	P	M	P	M	P	M

^a Special-status species legal status definitions:**Federal**

E = listed as endangered under the federal Endangered Species Act.

T = listed as threatened under the federal Endangered Species Act.

Table H2-2. Continued

- C1 = Category 1 candidate for federal listing. Category 1 includes species for which USFWS has on file enough substantial information on biological vulnerability and threat to support proposals to list them.
- C2 = Category 2 candidate for federal listing. Category 2 includes species for which USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

-- = no listing status.

State

E = listed as endangered under the California Endangered Species Act.

T = listed as threatened under the California Endangered Species Act.

SSC = DFG species of special concern.

-- = no listing status.

^b Codes for regular occurrence, as determined from results of various field surveys during 1988-1990 and NDDB.

Y = yes.

N = no.

P = possible (occurrence known or possible, but species may not occur regularly).

^c Habitat quality codes:

H = high.

M = moderate.

L = low.

U = unsuitable.

Table H2-3. Numbers of Birds in Species Groups Observed in February-May 1988
during Systematic Wildlife Ground Surveys

	Average Number of Birds per Survey Station				Average Number of Birds per Survey			
	Bacon	Webb	Bouldin	Holland	Bacon	Webb	Bouldin	Holland
Piscivorous birds	0.0	0.3	0.1	0.2	0.4	6.8	2.2	3.4
Wading birds	0.4	0.9	0.2	0.2	13.0	19.6	6.4	4.7
Raptors	0.7	2.5	0.8	2.2	20.5	54.3	31.5	48.7
Shorebirds	2.0	0.0	0.1	3.8	61.7	0.0	2.1	83.3
Gulls and terns	11.4	1.0	8.4	2.8	351.9	22.0	342.6	61.2
Riparian birds	2.7	7.0	1.7	13.5	82.2	154.2	69.2	297.0
Grassland birds	1.2	2.7	2.8	2.0	35.7	58.5	115.8	44.6
Swallows	0.5	0.0	1.9	1.6	14.3	0.0	77.4	35.8
Blackbirds/starlings	<u>2.4</u>	<u>0.6</u>	<u>7.4</u>	<u>22.4</u>	<u>74.4</u>	<u>12.3</u>	<u>303.4</u>	<u>492.8</u>
Total	21.1	14.9	23.2	48.7	654.1	327.7	950.4	1,071.4

Notes: See Table H2-5 for abundances of individual species.

Minor discrepancies in totals are due to rounding.

Table H2-4. Wildlife Species Observed or Potentially Occurring
on the DW Project Islands

Common Name	Scientific Name	Species Code
BIRDS		
* Pied-billed grebe	<i>Podilymbus podiceps</i>	PBGR
Horned grebe	<i>Podiceps auritus</i>	
Eared grebe	<i>Podiceps nigricollis</i>	
* Western grebe	<i>Aechmophorus occidentalis</i>	WEGR
* American white pelican	<i>Pelecanus erythrorhynchos</i>	AWPE
* Double-crested cormorant	<i>Phalacrocorax auritus</i>	DCCO
* American bittern	<i>Botaurus lentiginosus</i>	AMBI
* Great blue heron	<i>Ardea herodias</i>	GBHE
* Great egret	<i>Casmerodius albus</i>	GREG
* Snowy egret	<i>Egretta thula</i>	SNEG
* Cattle egret	<i>Bubulcus ibis</i>	CAEG
* Green-backed heron	<i>Butorides striatus</i>	GRHE
Black-crowned night heron	<i>Nycticorax nycticorax</i>	
* Tundra swan	<i>Cygnus columbianus</i>	TUSW
* Greater white-fronted goose	<i>Anser albifrons</i>	GWGO
* Snow goose	<i>Chen caerulescens</i>	SNGO
Ross' goose	<i>Chen rossii</i>	
* Canada goose	<i>Branta canadensis</i>	CAGO
Aleutian Canada goose	<i>Branta canadensis leucoparsia</i>	
* Wood duck	<i>Aix sponsa</i>	WODU
* Green-winged teal	<i>Anas crecca</i>	GWTE
* Mallard	<i>Anas platyrhynchos</i>	MALL
* Northern pintail	<i>Anas acuta</i>	NOPI
Blue-winged teal	<i>Anas discors</i>	
* Cinnamon teal	<i>Anas cyanoptera</i>	CITE
* Northern shoveler	<i>Anas clypeata</i>	NOSH
Gadwall	<i>Anas strepera</i>	
Eurasian wigeon	<i>Anas penelope</i>	
* American wigeon	<i>Anas americana</i>	AMWI
* Canvasback	<i>Aythya valisineria</i>	CANV
Redhead	<i>Aythya americana</i>	
* Ring-necked duck	<i>Aythya collaris</i>	RNDU
Lesser scaup	<i>Aythya affinis</i>	
* Common goldeneye	<i>Bucephala clangula</i>	COGO
Bufflehead	<i>Bucephala albeola</i>	
Common merganser	<i>Mergus merganser</i>	
* Ruddy duck	<i>Oxyura jamaicensis</i>	RUDU
* Turkey vulture	<i>Cathartes aura</i>	TUVU
* Black-shouldered kite	<i>Elanus caeruleus</i>	BSKI
Bald eagle	<i>Haliaeetus leucocephalus</i>	
* Northern harrier	<i>Circus cyaneus</i>	NOHA
* Sharp-shinned hawk	<i>Accipiter striatus</i>	SSHA

Table H2-4. Continued

Common Name	Scientific Name	Species Code
BIRDS (continued)		
* Cooper's hawk	<i>Accipiter cooperii</i>	COHA
* Red-shouldered hawk	<i>Buteo lineatus</i>	RSHA
* Swainson's hawk	<i>Buteo swainsoni</i>	SWHA
* Red-tailed hawk	<i>Buteo jamaicensis</i>	RTHA
Ferruginous hawk	<i>Buteo regalis</i>	
* Rough-legged hawk	<i>Buteo lagopus</i>	RLHA
Golden eagle	<i>Aquila chrysaetos</i>	
* American kestrel	<i>Falco sparverius</i>	AMKE
* Merlin	<i>Falco columbarius</i>	MERL
Peregrine falcon	<i>Falco peregrinus</i>	
Prairie falcon	<i>Falco mexicanus</i>	
* Ring-necked pheasant	<i>Phasianus colchicus</i>	RNPH
* California quail	<i>Callipepla californica</i>	CAQU
California black rail	<i>Laterallus jamaicensis coturniculus</i>	
* Virginia rail	<i>Rallus limicola</i>	VIRA
Sora	<i>Porzana carolina</i>	
* Common moorhen	<i>Gallinula chloropus</i>	COMO
* American coot	<i>Fulica americana</i>	AMCO
* Lesser sandhill crane	<i>Grus canadensis canadensis</i>	SACR
* Greater sandhill crane	<i>Grus canadensis tabida</i>	GSCR
Black-bellied plover	<i>Pluvialis squatarola</i>	
* Semipalmated plover	<i>Charadrius semipalmatus</i>	SEPL
* Killdeer	<i>Charadrius vociferus</i>	KILL
* Black-necked stilt	<i>Himantopus mexicanus</i>	BNST
* American avocet	<i>Recurvirostra americana</i>	AMAV
* Greater yellowlegs	<i>Tringa melanoleuca</i>	GRYE
* Lesser yellowlegs	<i>Tringa flavipes</i>	LEYE
Willet	<i>Catoptrophorus semipalmatus</i>	
* Whimbrel	<i>Numenius phaeopus</i>	WHIM
Long-billed curlew	<i>Numenius americanus</i>	
* Marbled godwit	<i>Limosa fedoa</i>	MAGO
* Western sandpiper	<i>Calidris mauri</i>	WESA
* Least sandpiper	<i>Calidris minutilla</i>	LESA
Dunlin	<i>Calidris alpina</i>	
Short-billed dowitcher	<i>Limnodromus griseus</i>	
* Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	LBDO
* Common snipe	<i>Gallinago gallinago</i>	COSN
Wilson's phalarope	<i>Phalaropus tricolor</i>	
* Bonaparte's gull	<i>Larus philadelphia</i>	BOGU
* Mew gull	<i>Larus canus</i>	MEGU
* Ring-billed gull	<i>Larus delawarensis</i>	RBGU
* California gull	<i>Larus californicus</i>	CAGU
Herring gull	<i>Larus argentatus</i>	
Thayer's gull	<i>Larus thayeri</i>	

Table H2-4. Continued

Common Name	Scientific Name	Species Code
BIRDS (continued)		
Glaucous-winged gull	<i>Larus glaucescens</i>	
* Caspian tern	<i>Sterna caspia</i>	CATE
Black tern	<i>Chlidonias niger</i>	
* Elegant tern	<i>Sterna elegans</i>	ELTE
* Forster's tern	<i>Sterna forsteri</i>	FOTE
* Rock dove	<i>Columba livia</i>	RODO
* Mourning dove	<i>Zenaida macroura</i>	MODO
* Common barn-owl	<i>Tyto alba</i>	COBO
Western screech owl	<i>Otus kennicottii</i>	
* Great horned owl	<i>Bubo virginianus</i>	GHOW
* Burrowing owl	<i>Athene cunicularia</i>	BUOW
Long-eared owl	<i>Asio otus</i>	
Short-eared owl	<i>Asio flammeus</i>	
Black-chinned hummingbird	<i>Archilochus alexandri</i>	
Anna's hummingbird	<i>Calypte anna</i>	
Allen's hummingbird	<i>Selasphorus sasin</i>	
* Belted kingfisher	<i>Ceryle alcyon</i>	BEKI
Lewis' woodpecker	<i>Melanerpes lewis</i>	
Red-breasted sapsucker	<i>Sphyrapicus ruber</i>	
* Nuttall's woodpecker	<i>Picoides nuttallii</i>	NUWO
* Downy woodpecker	<i>Picoides pubescens</i>	DOWO
Hairy woodpecker	<i>Picoides villosus</i>	
* Northern flicker	<i>Colaptes auratus</i>	NOFL
Western wood-pewee	<i>Contopus sordidulus</i>	
Western flycatcher	<i>Empidonax difficilis</i>	
* Willow flycatcher	<i>Empidonax traillii</i>	WIFL
* Black phoebe	<i>Sayornis nigricans</i>	BLPH
Say's phoebe	<i>Sayornis saya</i>	
* Western kingbird	<i>Tyrannus verticalis</i>	WEKI
* Horned lark	<i>Eremophila alpestris</i>	HOLA
Purple martin	<i>Progne subis</i>	
* Tree swallow	<i>Tachycineta bicolor</i>	TRSW
* Violet-green swallow	<i>Tachycineta thalassina</i>	VGSW
* Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	NRSW
* Cliff swallow	<i>Hirundo pyrrhonota</i>	CLSW
* Barn swallow	<i>Hirundo rustica</i>	BASW
* Scrub jay	<i>Aphelocoma coerulescens</i>	SCJA
* Yellow-billed magpie	<i>Pica nuttalli</i>	YBMA
* American crow	<i>Corvus brachyrhynchos</i>	AMCR
* Common raven	<i>Corvus corax</i>	CORA
* Plain titmouse	<i>Parus inornatus</i>	PLTI
* Bushtit	<i>Psaltiriparus minimus</i>	BUSH
Bewick's wren	<i>Thryomanes bewickii</i>	
* House wren	<i>Troglodytes aedon</i>	HOWR

Table H2-4. Continued

Common Name	Scientific Name	Species Code
BIRDS (continued)		
Winter wren	<i>Troglodytes troglodytes</i>	
* Marsh wren	<i>Cistothorus palustris</i>	MAWR
Golden-crowned kinglet	<i>Regulus satrapa</i>	
* Ruby-crowned kinglet	<i>Regulus calendula</i>	RCKI
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	
Western bluebird	<i>Sialia mexicana</i>	
Mountain bluebird	<i>Sialia currucoides</i>	
Swainson's thrush	<i>Catharus ustulatus</i>	
* Hermit thrush	<i>Catharus guttatus</i>	HETH
* American robin	<i>Turdus migratorius</i>	AMRO
Varied thrush	<i>Ixoreus naevius</i>	
* Northern mockingbird	<i>Mimus polyglottos</i>	NOMO
* Water pipit	<i>Anthus spinoletta</i>	WAPI
Cedar waxwing	<i>Bombycilla cedrorum</i>	
* Loggerhead shrike	<i>Lanius ludovicianus</i>	LOSH
* European starling	<i>Sturnus vulgaris</i>	EUST
Solitary vireo	<i>Vireo solitarius</i>	
Hutton's vireo	<i>Vireo huttoni</i>	
Warbling vireo	<i>Vireo gilvus</i>	
* Orange-crowned warbler	<i>Vermivora celata</i>	OCWA
Yellow warbler	<i>Dendroica petechia</i>	
* Yellow-rumped warbler	<i>Dendroica coronata</i>	YRWA
Black-throated gray warbler	<i>Dendroica nigrescens</i>	
Townsend's warbler	<i>Dendroica townsendi</i>	
MacGillivray's warbler	<i>Oporornis tolmiei</i>	
* Common yellowthroat	<i>Geothlypis trichas</i>	COYE
Wilson's warbler	<i>Wilsonia pusilla</i>	
Yellow-breasted chat	<i>Icteria virens</i>	
* Black-headed grosbeak	<i>Pheucticus melanocephalus</i>	BHGR
* Blue grosbeak	<i>Guiraca caerulea</i>	BLGR
* Luzuli bunting	<i>Passerina amoena</i>	LUBU
* Rufous-sided towhee	<i>Pipilo erythrophthalmus</i>	RSTO
Brown towhee	<i>Pipilo fuscus</i>	
* Savannah sparrow	<i>Passerculus sandwichensis</i>	SASP
Fox sparrow	<i>Passerella iliaca</i>	
* Song sparrow	<i>Melospiza melodia</i>	SOSP
* Lincoln's sparrow	<i>Melospiza lincolnii</i>	LISP
* Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	GCSP
* White-crowned sparrow	<i>Zonotrichia leucophrys</i>	WCSP
* Dark-eyed junco	<i>Junco hyemalis</i>	DEJU
* Red-winged blackbird	<i>Agelaius phoeniceus</i>	RWBL
Tricolored blackbird	<i>Agelaius tricolor</i>	
* Western meadowlark	<i>Sturnella neglecta</i>	WEME
* Yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	YHBL

Table H2-4. Continued

Common Name	Scientific Name	Species Code
BIRDS (continued)		
* Brewer's blackbird	<i>Euphagus cyanocephalus</i>	BRBL
* Brown-headed cowbird	<i>Molothrus ater</i>	BHCO
* Northern oriole	<i>Icterus galbula</i>	NOOR
Purple finch	<i>Carpodacus purpureus</i>	
* House finch	<i>Carpodacus mexicanus</i>	HOFI
Pine siskin	<i>Carduelis pinus</i>	
* Lesser goldfinch	<i>Carduelis psaltria</i>	LEGO
Lawrence's goldfinch	<i>Carduelis lawrencei</i>	
* American goldfinch	<i>Carduelis tristis</i>	AMGO
* House sparrow	<i>Passer domesticus</i>	HOSP
AMPHIBIANS		
Western toad	<i>Bufo boreas</i>	
* Pacific treefrog	<i>Hyla regilla</i>	
* Bullfrog	<i>Rana catesbeiana</i>	
REPTILES		
* Western pond turtle	<i>Clemmys marmorata</i>	
Western fence lizard	<i>Sceloporus occidentalis</i>	
Southern alligator lizard	<i>Gerrhonotus multicarinatus</i>	
Racer	<i>Coluber constrictor</i>	
* Gopher snake	<i>Pituophis melaneoleucus</i>	
Common garter snake	<i>Thamnophis sirtalis</i>	
Giant garter snake	<i>Thamnophis couchi gigas</i>	
MAMMALS		
* Virginia opossum	<i>Didelphis virginiana</i>	
* Broad-footed mole	<i>Scapanus latimanus</i>	
Yuma myotis	<i>Myotis yumanensis</i>	
California myotis	<i>Myotis californicus</i>	
Western pipistrelle	<i>Pipistrellus hesperus</i>	
Big brown bat	<i>Eptesicus fuscus</i>	
Red bat	<i>Lasiurus borealis</i>	
Hoary bat	<i>Lasiurus cinereus</i>	
Townsend's big-eared bat	<i>Plecotus townsendii</i>	
Pallid bat	<i>Antrozous pallidus</i>	
Brazilian free-tailed bat	<i>Tadarida brasiliensis</i>	
* Desert cottontail	<i>Sylvilagus audubonii</i>	

Table H2-4. Continued

Common Name	Scientific Name	Species Code
MAMMALS (continued)		
* Black-tailed hare	<i>Lepus californicus</i>	
* California ground squirrel	<i>Spermophilus beecheyi</i>	
* Botta's pocket gopher	<i>Thomomys bottae</i>	
* Beaver	<i>Castor canadensis</i>	
Western harvest mouse	<i>Reithrodontomys megalotis</i>	
Deer mouse	<i>Peromyscus maniculatus</i>	
California vole	<i>Microtus californicus</i>	
* Muskrat	<i>Ondatra zibethicus</i>	
Black rat	<i>Rattus rattus</i>	
Norway rat	<i>Rattus norvegicus</i>	
House mouse	<i>Mus musculus</i>	
* Coyote	<i>Canis latrans</i>	
* Red fox	<i>Vulpes vulpes</i>	
* Raccoon	<i>Procyon lotor</i>	
Long-tailed weasel	<i>Mustela frenata</i>	
Mink	<i>Mustela vison</i>	
* Striped skunk	<i>Mephitis mephitis</i>	
* River otter	<i>Lutra canadensis</i>	
* Species observed on the DW project islands during field surveys.		

Table H2-5. Relative Abundances of Bird Species on the DW Project Islands, as Determined from Ground Surveys Conducted during February-May 1988

Species Number	Species Code	Average Number of Birds per Station				Average Number of Birds per Survey			
		Bacon	Webb	Bouldin	Holland	Bacon	Webb	Bouldin	Holland
2	PBGR	0.00	0.02	0.05	0.04	0.00	0.40	2.05	0.83
3	WEGR	0.00	0.01	0.00	0.00	0.00	0.22	0.00	0.00
4	AWPE	0.00	0.22	0.00	0.00	0.84	0.00	0.00	0.00
5	DCCO	0.01	0.04	0.00	0.11	0.88	0.10	0.00	2.48
6	AMBI	0.01	0.01	0.00	0.00	0.23	0.22	0.21	0.00
7	GBHE	0.05	0.08	0.04	0.01	1.55	1.76	1.54	0.28
8	GREG	0.14	0.64	0.11	0.13	4.26	14.08	4.31	2.75
9	SNEG	0.11	0.01	0.01	0.05	3.49	0.22	0.21	1.10
10	CAEG	0.00	0.14	0.00	0.01	3.08	0.00	0.00	0.28
11	EGRET SP.	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	GRHE	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
13	TUSW	9.76	0.74	2.56	0.41	16.28	105.06	9.08	0.00
14	GWGO	2.93	17.72	17.13	0.15	389.84	702.13	3.30	0.00
15	SNGO	5.56	0.76	0.01	11.08	16.72	0.21	243.76	1.76
16	CAGO	0.12	0.22	1.38	0.08	4.84	56.38	1.76	0.00
17	WODU	0.00	0.00	0.00	0.01	0.00	0.00	0.14	0.00
18	GWTE	0.00	0.02	0.00	0.18	0.44	0.00	0.00	3.85
19	MALL	0.19	1.28	0.28	1.13	28.16	11.28	24.75	19.25
20	NOPI	0.24	1.18	.00	0.88	7.29	0.00	18.70	8.25
21	CITE	0.05	0.56	0.13	0.85	12.32	5.13	18.70	30.25
22	NOSH	0.01	0.00	0.00	0.38	0.27	0.00	0.00	0.28
23	AMWI	0.23	0.12	0.00	1.38	6.98	2.64	0.00	0.00
24	CANV	0.00	0.00	0.00	0.01	0.12	0.00	0.00	0.00
25	RNDU	0.00	0.02	0.00	0.00	0.44	0.00	0.00	0.00
26	COGO	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
27	RUDU	0.18	0.00	0.50	5.54	0.00	0.10	0.00	11.00
28	DUCK SP.	0.73	16.76	0.64	22.48	368.72	26.14	11.00	0.28
29	TUVU	0.04	0.01	0.00	1.16	0.18	0.10	0.00	0.00
30	BSKI	0.06	1.08	0.15	0.89	23.76	5.95	19.25	5.50
31	NOHA	0.14	0.52	0.17	0.25	4.26	11.44	7.07	0.14
32	SSHA	0.00	0.00	0.00	0.01	0.00	0.10	0.00	0.14
33	COHA	0.00	0.04	0.02	0.01	0.88	0.72	0.14	0.11
34	ACCIPTR	0.00	0.06	0.00	0.01	1.32	0.00	0.00	0.28
35	RSHA	0.00	0.02	0.00	0.01	0.44	0.00	0.00	0.00
36	SWHA	0.00	0.00	0.00	0.01	0.00	0.10	0.00	0.14
37	RTHA	0.16	0.58	0.22	0.88	5.04	9.02	19.25	0.14
38	RLHA	0.03	0.00	0.05	0.01	0.78	2.05	0.14	0.55
39	BUTEO SP.	0.00	0.00	0.03	0.03	0.00	1.03	0.00	2.75
40	AMKE	0.18	0.20	0.11	0.13	5.62	4.61	0.00	0.00
41	MERL	0.01	0.00	0.00	0.35	0.00	0.00	0.00	0.00
42	RAPTOR SP.	0.04	0.00	0.01	1.16	0.00	0.51	0.00	0.00
43	RNPH	0.03	0.14	0.06	0.38	0.78	2.56	0.00	0.83
44	CAQU	0.03	0.00	0.00	0.04	0.00	0.00	0.00	0.28
45	VIRA	0.00	0.01	0.00	0.01	0.00	0.22	0.00	0.00
46	COMO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	AMCO	1.25	1.28	0.13	13.88	38.75	5.13	305.25	0.00
48	SACR	0.00	0.00	1.09	0.00	0.00	44.84	0.00	0.00
49	GSCR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	SEPL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table H2-5. Continued

Species Number	Species Code ¹	Average Number of Birds per Station				Average Number of Birds per Survey			
		Bacon	Webb	Bouldin	Holland	Bacon	Webb	Bouldin	Holland
51	KILL	0.03	0.01	0.05	0.10	0.78	0.22	1.95	2.20
52	BNST	0.00	0.00	0.00	0.13	0.00	0.00	0.00	2.75
53	AMAV	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.28
54	GRYE	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.55
55	LEYE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	WHIM	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.25
57	MAGO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	WESA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	LESA	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
60	LBDO	0.00	0.00	0.00	0.64	0.00	0.00	0.00	14.03
61	COSN	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
62	SHOREBIRDS	1.96	0.00	0.00	2.88	60.84	0.00	0.00	63.25
63	BOGU	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.25
64	RBGU	0.00	0.00	0.22	1.11	0.00	0.00	8.87	24.48
65	CAGU	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.83
66	GULL SP.	11.35	1.00	8.14	1.50	351.85	22.00	333.64	33.00
67	CATE	0.00	0.00	0.00	0.11	0.00	0.00	0.00	2.42
68	FOTE	0.00	0.00	0.00	0.01	0.00	0.10	0.25	0.25
69	RODO	0.01	0.01	0.07	0.05	0.27	0.22	2.82	1.10
70	MODO	0.01	0.48	0.05	0.43	0.23	10.56	2.05	9.35
71	COBO	0.00	0.02	0.00	0.01	0.00	0.44	0.00	0.14
72	GHOW	0.00	0.00	0.01	0.01	0.00	0.00	0.21	0.14
73	BUOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74	BEKI	0.01	0.00	0.00	0.05	0.39	0.00	0.00	1.10
75	NUWO	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.55
76	DOWO	0.01	0.00	0.00	0.00	0.39	0.00	0.00	0.00
77	NOFL	0.01	0.06	0.03	0.03	0.39	1.32	1.03	0.55
78	WIFL	0.00	0.00	0.03	0.03	0.00	0.00	1.03	0.55
79	BLPH	0.01	0.06	.05	0.08	0.39	1.32	2.05	1.65
80	WEKI	0.00	0.00	-0.01	0.00	0.00	0.00	0.51	0.00
81	HOLA	0.04	0.00	0.06	0.00	1.16	0.00	2.56	0.00
82	TRSW	0.00	0.00	0.00	0.13	0.00	0.00	0.00	2.75
83	VGSW	0.00	0.00	0.03	1.25	0.00	0.00	1.03	27.50
84	NRSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85	CLSW	0.45	0.00	1.55	13.95	0.00	0.00	63.55	0.00
86	BASW	0.01	0.00	0.31	0.25	0.39	0.00	12.81	5.50
87	SCJA	0.03	0.00	0.01	0.18	0.78	0.00	0.51	3.85
88	YBMA	0.00	0.00	0.01	0.00	0.00	0.00	0.51	0.00
89	AMCR	0.34	0.76	1.38	0.68	10.46	16.72	56.38	14.85
90	CORA	0.00	0.06	0.00	0.00	0.00	1.32	0.00	0.00
91	PLTI	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.55
92	BUSH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93	HOWR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
94	MAWR	0.00	0.12	0.01	0.05	0.00	2.64	0.51	1.10
95	RCKI	0.00	0.12	0.00	0.08	0.00	2.64	0.00	1.65
96	HETH	0.03	0.00	0.00	0.00	0.78	0.00	0.00	0.00
97	AMRO	0.36	0.00	0.08	0.93	11.24	0.00	3.08	20.35
98	NOMO	0.00	0.00	0.00	0.05	0.00	0.00	0.00	1.10
99	WAPI	0.00	0.06	0.34	0.00	0.00	1.32	13.84	0.00

Table H2-5. Continued

Species Number	Species Code	Average Number of Birds per Station				Average Number of Birds per Survey			
		Bacon	Webb	Bouldin	Holland	Bacon	Webb	Bouldin	Holland
100	LOSH	0.00	0.16	0.00	0.00	0.00	3.52	0.00	0.00
101	EUST	0.04	0.00	0.11	.58	1.16	0.00	4.61	12.65
102	OCWA	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.55
103	YRWA	0.06	0.16	0.01	0.23	1.94	3.52	0.51	4.95
104	COYE	0.01	0.16	0.00	0.05	0.39	3.52	0.00	1.10
105	BHGR	0.00	0.06	0.00	0.00	0.00	1.32	0.00	0.00
106	BLGR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
107	LUBU	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.55
108	RSTO	0.03	0.16	0.03	0.38	0.78	3.52	1.03	8.25
109	SASP	0.09	0.00	0.03	0.13	2.71	0.00	1.03	2.75
110	SOSP	0.34	0.46	.15	0.88	10.46	10.12	6.15	19.25
111	LISP	0.01	0.06	0.01	0.20	0.39	1.32	0.51	4.40
112	GCSP	0.18	0.06	0.00	0.43	5.43	1.32	0.00	9.35
113	WCSP	0.88	4.00	0.58	0.68	27.13	88.00	23.58	14.85
114	DEJU	0.00	0.00	0.00	0.05	0.00	0.00	0.00	1.10
115	RWBL	0.21	0.56	4.36	9.75	6.59	12.32	178.86	214.50
116	WEME	0.39	0.06	0.81	0.50	12.01	1.32	33.31	11.00
117	YHBL	0.00	0.00	0.00	10.15	0.00	0.00	0.00	223.30
118	BRBL	0.40	0.00	0.41	0.00	12.40	0.00	16.91	0.00
119	BLACKBIRD SP.	1.79	0.00	2.63	2.50	55.41	0.00	107.63	55.00
120	BHCO	0.00	0.10	0.03	0.08	0.00	2.20	1.03	1.65
121	NOOR	0.00	0.00	0.21	0.00	0.00	0.00	8.71	0.00
122	HOFT	0.65	1.48	0.45	9.13	20.15	32.56	18.45	200.75
123	LEGO	0.26	1.26	0.00	0.05	8.14	27.72	0.00	1.10
124	AMGO	0.00	0.20	0.00	0.03	0.00	4.40	0.00	0.55
125	GOLDFINCH SP.	0.00	0.00	0.05	0.00	0.00	0.00	2.05	0.00
126	HOSP	0.05	0.05	0.05	0.00	1.55	1.10	2.05	0.00

* See Table H2-4 for code definitions.

Table H2-6. Habitat-Type Classification for the DW Project Islands

Habitat Group	Description	Comments	Dominant or Typical Plant Species
Riparian	Cottonwood-willow woodland Great Valley willow scrub	Cottonwood and willow trees Willow shrubs and trees	Fremont cottonwood, red willow, yellow willow Red willow, yellow willow, sandbar willow, Goodding's willow
Marsh	Freshwater marsh	Inside islands	Cattail, bulrush, yellow nutsedge, pondweed, buttonbush
	Tidal marsh	Outside main islands	Common tule, common reed, Olney's bulrush, California bulrush, common rush
	Exotic marsh*	Dense upland and wetland weeds (sometimes dry in summer)	Annual smartweed, peppergrass, amaranth, wild radish, nettles, cocklebur, watergrass
Woody, non-native	Mature trees Mixed ornamental	Shade trees and windbreaks Shrubs and lawn	Eucalyptus, pine, elm Turf grasses, miscellaneous ornamental shrubs
Herbaceous upland	Annual grassland Exotic perennial grassland*	True uplands and sand hills Mixed weeds in fields and on levee slopes	Wild oats, barley, rip-gut brome, Italian rye-grass Bermuda grass, perennial ryegrass, Johnson grass
Agriculture	Grain and seed crops Perennial crops Pasture	Permanently grazed	Corn, wheat, sunflowers, potatoes Asparagus, vineyards Tall fescue, orchard grass, canary grass, ryegrass, legumes
	Fallow	Short-term fallow fields	Yellow star-thistle, Russian thistle, houseweed, lamb's quarters, telegraph weed
Open water	Canals and ditches Permanent ponds Mudflats	Permanent water Still water Tidal, open bare mud	Dallis grass, knot grass, Himalaya berry, smartweed Water hyacinth, water primrose, azolla None
Developed	Structures Paving and exposed earth	Buildings and marinas Roads, landfills, and unvegetated exposed areas	Largely unvegetated

* Exotic habitats are dominated by weedy plant species that are not native to the Delta.

Source: JSA 1988.

Table H2-7. Total Use of the DW Project Islands by Major Waterfowl Groups during November-May 1987-1988 (Waterfowl Use-Days)

Island	Swans	Geese	Ducks	Total
Bacon	43,270	57,630	8,640	109,540
Webb	71,740	777,950	366,880	1,216,580
Bouldin	25,180	43,690	37,980	106,850
Holland	<u>1,330</u>	<u>7,810</u>	<u>10,750</u>	<u>19,890</u>
Total	141,520	887,080	424,250	1,452,860

Note: Waterfowl use-days were calculated by multiplying average populations recorded during aerial surveys (Table H2-8) by the number of days in each count period.

Table H2-8. Average Waterfowl Numbers Observed during Aerial Surveys
during Monthly or Bimonthly Count Periods

Species	Island	Count Period ^a				
		November (N = 3) ^b	December- January (N = 5) ^b	February- March (N = 8) ^b	April (N = 3) ^b	May (N = 2) ^b
Tundra swan	Bacon	0	460	250	0	0
	Webb	0	1,100	60	0	0
	Bouldin	120	310	40	0	0
	Holland	<u>4</u>	<u>10</u>	<u>10</u>	<u>0</u>	<u>0</u>
	Total	124	1,880	360	0	0
Greater white-fronted goose	Bacon	0	60	140	310	0
	Webb	0	530	1,600	1,900	45
	Bouldin	5	300	200	180	0
	Holland	<u>0</u>	<u>0</u>	<u>4</u>	<u>210</u>	<u>0</u>
	Total	5	890	1,944	2,600	45
Snow goose	Bacon	0	5	560	100	0
	Webb	0	4,700	4,700	470	15
	Bouldin	0	50	60	0	0
	Holland	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	Total	0	4,755	5,320	570	15
Canada goose	Bacon	0	0	0	0	0
	Webb	0	140	6	0	0
	Bouldin	0	5	10	0	0
	Holland	<u>0</u>	<u>20</u>	<u>0</u>	<u>1</u>	<u>0</u>
	Total	0	165	16	1	0
Dabbling ducks	Bacon	0	80	55	4	10
	Webb	1,215	5,400	240	150	27
	Bouldin	440	540	30	15	3
	Holland	<u>35</u>	<u>30</u>	<u>65</u>	<u>100</u>	<u>60</u>
	Total	1,690	6,050	390	269	100
Total of all waterfowl ^c		<u>1,819</u>	<u>13,740</u>	<u>8,030</u>	<u>3,440</u>	<u>160</u>

Note: N = number of surveys per period.

^a November data are from 1988; remaining periods were sampled during December 1987 to May 1988.

^b Number of surveys per period.

^c Total of all waterfowl represents average numbers of all waterfowl species observed on all islands during each count period.

Table H2-9. Waterfowl Use of Habitats on the DW Project Islands, as Determined from 1987-1988 Aerial Surveys

Species	Island	Crops								Pond	Ditch	Pasture
		Flooded				Unflooded						
		Disked		Undisked		Disked		Undisked				
Tundra swan	Bacon	2,738	(89)	0		232	(8)	30	(1)	0		
	Webb	1,362	(24)	400	(7)	2,480	(43)	1,475	(26)	4	(0)	
	Bouldin	746	(71)	4		20	(2)	280	(26)	0		
	Holland	51	(62)	20	(24)	7	(9)	0		7	(9)	
	Total	4,897	(50)	424	(4)	2,739	(28)	1,785	(18)	11	(0)	
Greater white-fronted goose	Bacon	630	(35)			1,190	(65)	0		0		0
	Webb	0				1,185	(5)	4,574	(20)	17,514	(75)	93 (0)
	Bouldin	1,135	(59)			319	(17)	454	(24)	0		10 (1)
	Holland	0				0		0		0		20 (3)
	Total	1,765	(7)			2,694	(10)	5,028	(19)	17,514	(65)	123 (0)
Snow goose	Bacon	20	(0)	0		4,800	(100)	0		0		
	Webb	276		5,000	(11)	0		14,300	(31)	26,700	(58)	
	Bouldin	256	(34)	0		500	(66)	0		0		
	Holland	0		0		0		0		0		
	Total	276	(1)	5,000	(10)	5,300	(10)	14,300	(28)	26,700	(52)	
Canada goose	Bacon					0		0		0		
	Webb					0		550	(99)	8	(1)	
	Bouldin					96	(81)	20	(17)	0		
	Holland					0		0		0		
	Total					96	(14)	570	(84)	8	(1)	
Mallard	Bacon	46	(49)	0		0				0	47 (51)	
	Webb	104	(3)	54	(2)	50	(2)			2,998	(91)	87 (3)
	Bouldin	70	(22)	0		0				10	(3)	226 (70)
	Holland	177	(27)	0		0				440	(66)	33 (5)
	Total	397	(9)	54	(1)	50	(1)			3,448	(79)	393 (9)
Pintail	Bacon	442	(100)							0		
	Webb	0								760	(100)	
	Bouldin	0								0		
	Holland	0								0		
	Total	442	(37)							760	(63)	

Table H2-9. Continued

Species	Island	Crops				Pond	Ditch	Pasture	
		Flooded		Unflooded					
		Disked	Undisked	Disked	Undisked				
Unidentified ducks	Bacon	165	(99)	0		2	(1)	0	
	Webb	0		0		1,048	(98)	20	(2)
	Bouldin	0		0		44	(69)	0	
	Holland	70	(18)	1	(0)	217	(55)	20	(5)
	Total	235	(14)	1	(0)	1,311	(78)	40	(2)
								87	(22)
								87	(5)

Notes: Cell entries are: 1) average numbers of birds observed per survey period; and 2) in parentheses, percentages of all birds of a species within each habitat on each island. (Thus, percentages total to 100 along each row, except for rounding error.)

Blank values in table are zeroes.

Crops regularly flooded for weed control include corn, harvested wheat, sunflower, and asparagus on Bacon and Bouldin Islands only. Flooding occurs temporarily on Webb and Holland Tracts and other areas of Bacon and Bouldin Islands following rainstorms. Some flooded areas reported as disked may have been harvested undisked wheat fields.

Table H2-10. Relative Abundances of Upland Game Birds on the DW Project Islands
as Determined from Ground Surveys

Species	Average Number per Survey Station				Average Number per Survey (All Stations)			
	Bacon	Webb	Bouldin	Holland	Bacon	Webb	Bouldin	Holland
Ring-necked pheasant	0.03	0.14	0.06	0.38	0.78	3.08	2.56	8.25
California quail	0.03	0.00	0.00	0.04	0.78	0.00	0.00	0.83
Mourning dove	0.01	0.48	0.05	0.43	0.23	10.56	2.05	9.35
<p>Note: Averages were derived from systematic wildlife ground surveys conducted during February-May 1988. See Table H-1 for details on number and timing of surveys.</p>								

Table H2-11. Availability of Waste Corn on the DW Project Islands

Island	Acres Planted	Mean Pounds/Acre ^a	Total Waste Food Available (pounds)
Bacon	776	87	67,500
Webb	2,223	255	567,000
Bouldin	2,459	87	213,900
Holland	<u>238</u>	255	<u>61,000</u>
All islands	5,696		909,400

^a Waste corn was measured on Bouldin Island and Webb Tract; availability rates were applied to Bacon Island and Holland Tract based on similarity in management intensity. Lower estimates for Bacon and Bouldin Islands reflect greater harvest efficiency and the disking of one-half the corn acreage following harvest. Measured corn availability on Bouldin Island (in pounds/acre \pm standard error) for undisked fields was 106 ± 24.5 and for disked fields was 68 ± 15.5 . Availability in undisked fields at Webb Tract was 255 ± 58.6 pounds/acre).

Source: JSA 1989.

Table H2-12. Estimated Hunting Harvests of Game Species
on the DW Project Islands

Island	Estimated Number of Birds Harvested per Year			
	Geese	Ducks	Pheasants	Quail and Doves
Bacon	0	0	0	0
Webb	50	350	60	10
Bouldin	15	170	30	0
Holland	<u>5</u>	<u>25</u>	<u>15</u>	<u>10</u>
Total	70	545	105	20

Sources: Shimasaki pers. comm. for Bacon Island, Wilkerson pers. comm. for Bouldin Island, Frelie pers. comm. for Holland Tract, and Dinelli pers. comm. for Webb Tract.

Table H2-13. Waterfowl Use of Holland Tract Demonstration Wetland
after Water Levels Were Raised in January 1989

Species	Survey Date					Average Population	Average Daily Density (number of birds per day)
	1/23 ^a	2/3	2/16 ^b	2/23 ^a	3/23 ^a		
Tundra swan		5	1			1	0.02
Green-winged teal	100			50		30	0.50
Mallard	50	100	3	40	40	47	0.78
Northern pintail	250	2,700	3	10		603	10.05
Cinnamon teal		1			50	10	0.17
Northern shoveler			12	2	12	5	0.08
Gadwall		2			4	1	0.02
American wigeon			1			0	0.00
Canvasback	500	350		15	10	175	2.92
Ring-necked duck					12	2	0.03
Scaup species	2				20	4	0.67
Common goldeneye				2	4	1	0.02
Bufflehead				2	10	2	0.03
Hooded merganser					2	0	0.00
Ruddy duck	350	250	10		30	128	2.13
American coot	500	300	135		100	<u>207</u>	<u>3.45</u>
Total						1,216	20.27

^a Data provided by Miller (pers. comm.).

^b Baugh (pers. comm.) reported that prior to surveys on this day, a larger number of birds had been scared off of the ponds by adjacent agricultural operations.

Table H2-14. Average Number of Northern Harriers Observed
Monthly during Ground Surveys in 1988

Island	Average Number per Survey			
	February (4)	March (2)	April (1)	May-June (1)
Bacon	5	3	2	0
Webb	14	No data	No data	0
Bouldin	8	11	4	0
Holland	7	6	4	7

Note: The number in parentheses is the number of surveys conducted.

Table H2-15. Average Numbers of Sandhill Cranes Observed Monthly
in Aerial and Ground Surveys on Bouldin Island

Survey Method	Sandhill Crane Subspecies	Average Number per Survey							
		October 1990	November 1988	December 1989	January 1989	February 1989	March 1989	April 1989	May 1989
Aerial	Greater and lesser	NS	33 (3)	106 (5)	29 (3)	27 (4)	0 (4)	0 (3)	0 (2)
Ground	Greater	0 (1)	NS	NS	NS	84 (4)	1 (2)	0 (1)	0 (1)
	Lesser	95	NS	NS	NS	4	0	0	0

Notes: The number in parentheses is the number of surveys conducted.

NS = no surveys were conducted during this period.

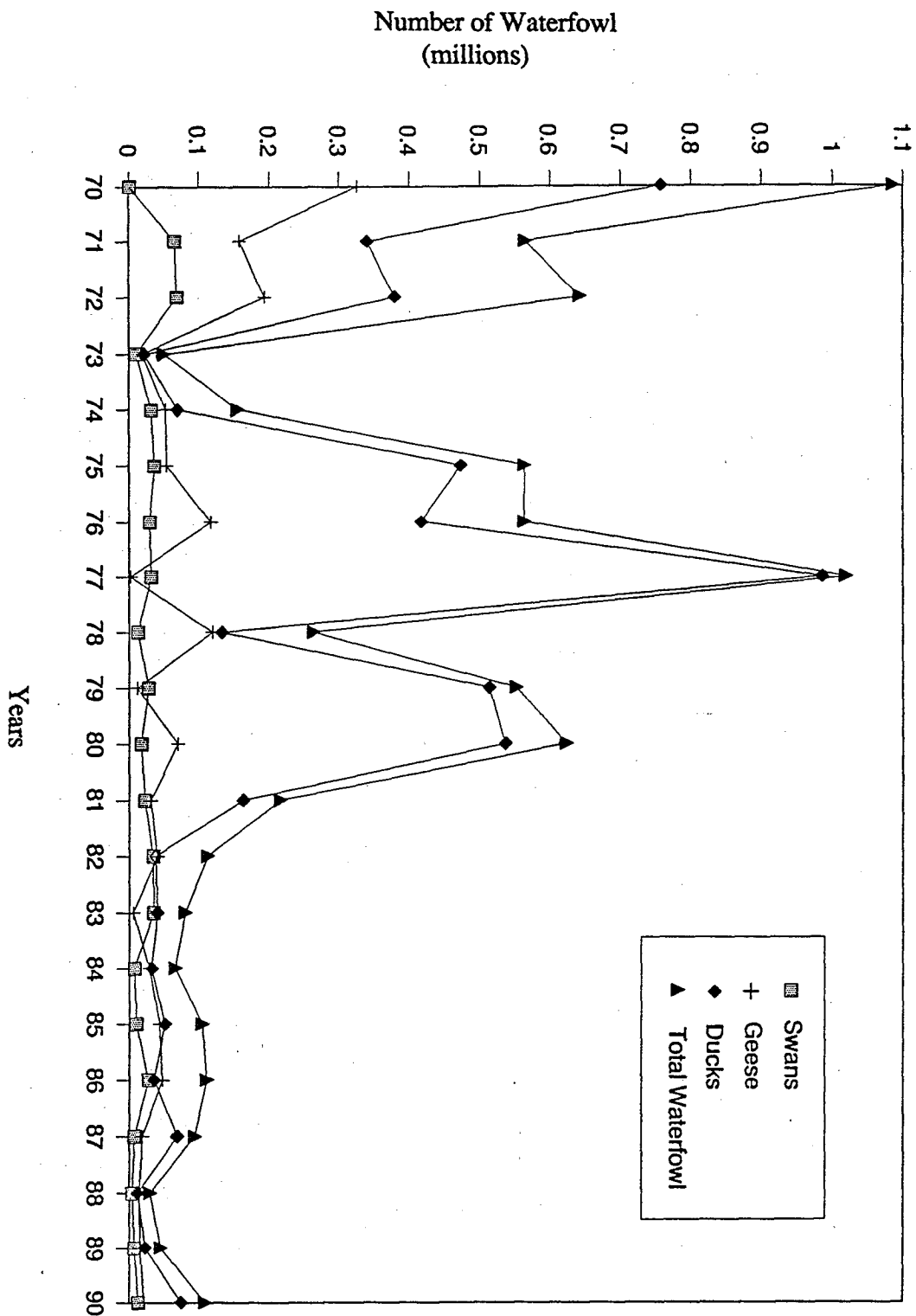


Figure H2-1.
Recent Waterfowl Populations Observed in the Annual Midwinter
Delta Survey, 1970-1990